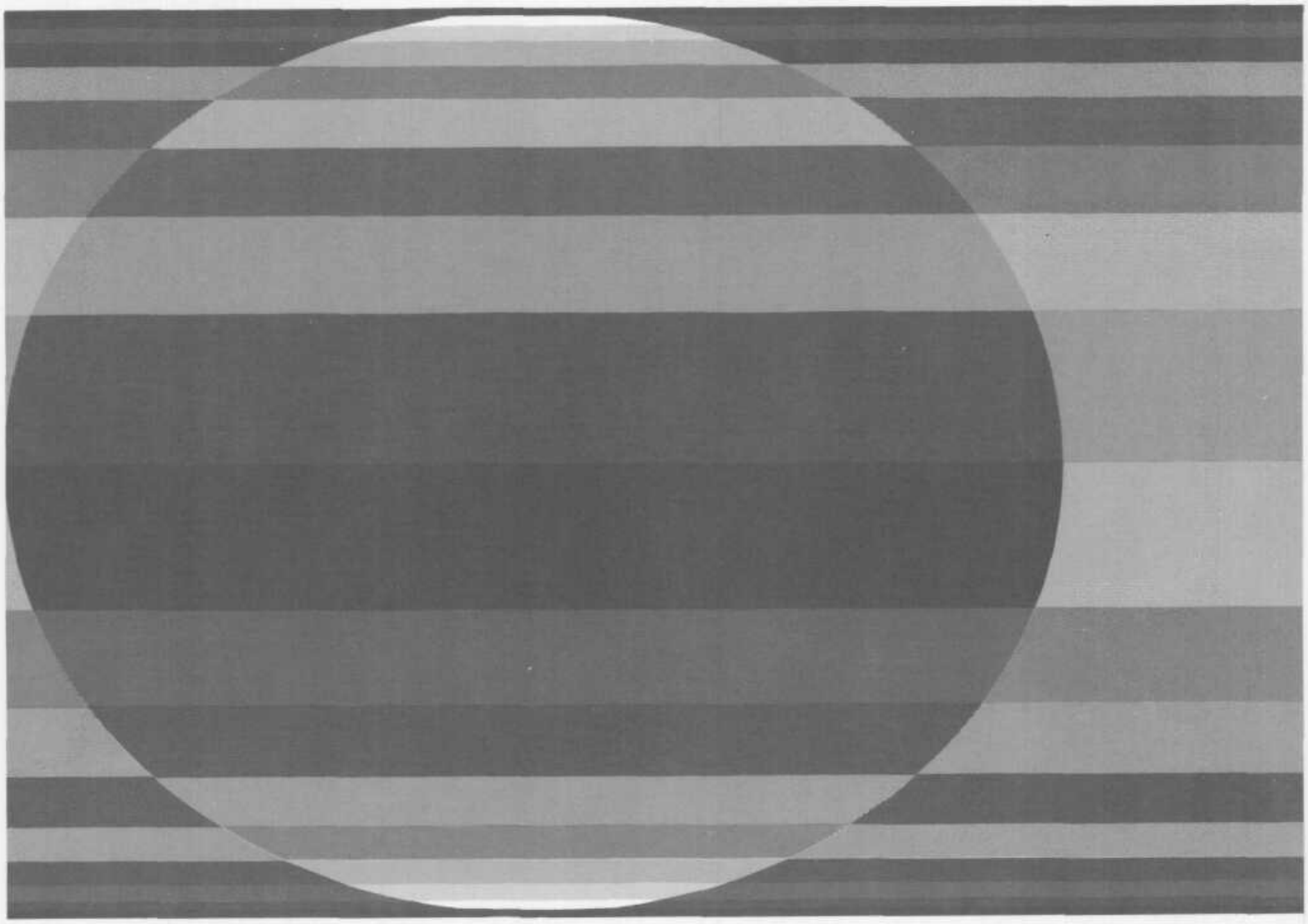
BACKGROUND PAPER

The U.S. Sea Control Mission: Forces, Capabilities, and Requirements

JUNE 1977



Congress of the United States
Congressional Budget Office
Washington, D.C.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **JUN 1977**	2. REPORT TYPE	3. DATES COVERED **00-00-1977 to 00-00-1977**

4. TITLE AND SUBTITLE
The U.S. Sea Control Mission: Forces, Capabilities, and Requirements

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Congressional Budget Office ,Ford House Office Building, 4th Floor ,Second and D Streets, SW ,Washington,DC,20515-6925

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR’S ACRONYM(S)

11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**100**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

THE U.S. SEA CONTROL MISSION: FORCES, CAPABILITIES, AND REQUIREMENTS

The Congress of the United States
Congressional Budget Office

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

PREFACE

A significant portion of the defense budget goes to procure and operate naval forces for the mission of "sea control." This paper, prepared at the request of Chairman Muskie of the Senate Budget Committee, examines that mission and analyzes some alternatives, both naval and nonnaval, for performing it. It should be of particular use to the Congress as the requests for shipbuilding and procurement of aircraft are debated.

This paper was prepared by Dov S. Zakheim of the National Security and International Affairs Division of the Congressional Budget Office, under the supervision of Robert B. Pirie, Jr. and John E. Koehler. The author wishes to acknowledge the assistance of James A. Capra, Patrick L. Renehan, and Edward A. Swoboda of the CBO Budget Analysis Division, and John W. Ellwood, Special Assistant to the Director. The paper was edited by Patricia W. Johnston, and Linda S. Moll and Nancy J. Swope prepared the several drafts.

Alice M. Rivlin
Director

June 1977

CONTENTS

TABLES

FIGURE

SUMMARY

The Department of Defense (DoD) views a war in Europe between NATO and the Warsaw Pact as the most demanding scenario for its forward strategy. The sea control mission is a critical element of that forward strategy, particularly if the war were fought over an extended period. Sea-lanes to Europe would have to be defended against possible Soviet air, surface, and submarine attacks if timely and sufficient supplies are to reach our Allies and our forces deployed there. Traditionally, requirements for accomplishing the sea control mission have been expressed primarily as "naval" force goals. Technological change and the geographic position of our Allies vis-a-vis the Soviet Union would make it possible, however, for land-based units to play a significant role in key aspects of the sea control effort.

Defending Against the Soviet Air Threat

The potential for a land-based contribution is especially evident with respect to the defense of the Atlantic sea-lanes against the Soviet bomber threat. Soviet aviation might represent the most significant immediate potential threat to those sea-lanes. Its major route to the North Atlantic from Soviet bases would likely skirt Norway and cross the Greenland-Iceland-United Kingdom (G-I-UK) gap. The gap provides a natural geographic barrier for the early detection and interdiction of hostile Soviet aircraft. Land-based systems, in Norway, Britain and Iceland, could, and presently do, provide some early warning and interdiction capability against Soviet aviation. The proximity of Norwegian air bases to Soviet territory renders them vulnerable to surprise attacks and even seizure, however, while U.S. early warning and interceptor forces in Iceland are obsolescent and provide little real capability against modern Soviet aircraft.

The vulnerability of Atlantic shipping to Soviet air attack would be compounded by uncertainties about the warning time available to the Allies before the start of hostilities. With only about a week's warning, it would be unlikely that carrier-based forces could arrive in Iceland in time to supplement the small defense force stationed there. Other forces, which might be

rapidly deployed from the United States, might have other commitments that would take priority over reinforcing the Iceland Defense Force. If it is indeed assumed that little strategic warning time would be available to the Allies before the start of an attack, the air defense forces deployed to Iceland would have to bear the brunt of that attack on their own. These forces could continue to be land-based, as they are now. Both the E-3A airborne early warning and control system (AWACS) and a land-based, extended-range version of the Navy E-2C early warning aircraft could provide the required timely detection of the approach of Soviet aircraft. Modern interceptors, such as the F-14, F-15, F-16, or even the F-4E, could significantly increase the limited capability of the F-4C squadron presently stationed in Iceland.

Of the two early-warning, long-range detection planes, the AWACS has the greater unit procurement and operating costs. But its command and control and radar capabilities, as well as endurance, are significantly greater as well. The latter results in a partial offset of the unit cost advantage of the Navy plane. Thus a force of only five AWACS could provide the same early warning capability as eleven of the extended-range E-2Cs. Table S-1 indicates that the fifteen-year cost of the E-3A program is 20 percent greater than the equivalent cost of an E-2C program. It is possible, though uncertain, however, that the technical capabilities of AWACS are sufficiently superior to those of E-2C to offset fully the cost differential.

TABLE S-1. E-2C AND E-3A: COST OF MAINTAINING CONTINUOUS 30-DAY STATION, 450 NM. FROM BASE, IN MILLIONS OF FISCAL YEAR 1978 DOLLARS

Plane	Total 15-Year Procurement and Operating Cost
E-2C (extended range)	981
E-3A AWACS	1,181

With respect to the choice of an interceptor, the F-4E option would represent a stopgap measure, designed to provide immediate improvement of the Iceland interceptor force while avoiding the need to transfer the latest interceptors to Keflavik. Of the remaining alternatives, the F-16 would be the least attractive as an interceptor option, because it does not carry a medium-range, air-to-air missile. The F-14 carries the Phoenix system, reputedly the most capable air-to-air system in the U.S. arsenal. The F-15 carries the less capable Sparrow, but it is a less expensive aircraft. Since the requirement for improving the interceptor force is clearly a pressing one, choices of an interceptor will depend as much upon immediate availability as upon cost and effectiveness.

There is a sea-based alternative to replacing Iceland forces with other land-based assets. The Navy could permanently deploy an aircraft carrier to the G-I-UK area. Unless Pacific carrier forces are significantly reduced, however, a new carrier would have to be procured to support this additional deployment. The cost associated with the procurement of a carrier, its air wing, and associated escorts would far exceed those of procuring land-based early warning and interceptor aircraft. Indeed, the carrier option would be far more expensive even if carrier and escorts were not procured (see Table S-2).

TABLE S-2. LAND-BASED AVIATION AND CARRIER TASK FORCE (CTF) OPTIONS: COMPARISON OF PROCUREMENT AND 15-YEAR TOTAL COSTS, IN MILLIONS OF FISCAL YEAR 1978 DOLLARS

Option	Procurement	15-Year Total Cost
E-3A/F-14	1,625	2,916
E-2C/F-14	1,877	2,717
CTF (no carrier or escort procured)	328	5,188
CTF (one carrier and escorts procured)	5,190	9,276
2 CTF (redeploy to Atlantic during mobilization)	--	9,480

The carrier alternative likewise is more costly ($9.5 billion fiscal year 1978 dollars) even if it is assumed that several weeks strategic warning time will be available to the Allies. In that case, however, peacetime deployments need not be altered. The costs associated with air defense in the G-I-UK gap would also account for maintaining the present level both of U.S. peacetime presence in Asia, and U.S. naval warfighting capabilities in the event of a non-NATO conflict. Nevertheless, given a wartime need for some carrier capability in the Pacific, as well as for carriers in the Mediterranean and mid-Atlantic regions, the present carrier force could barely meet a requirement for carrier-based air defense in the G-I-UK gap. If carriers were assumed to be vulnerable to Soviet attacks in areas like the Mediterranean, the present force would have to provide replacements for disabled carriers, as well as support its other programmed deployments. In those circumstances, there might not be enough carriers to provide for operations in the G-I-UK gap as well, and more carriers would have to be procured.

Responding to the Soviet Submarine Threat

In contrast to the threat that Soviet aviation poses to Atlantic shipping, the Soviet submarine force represents the longest-term, most sustained threat to free Allied use of the Atlantic sea lane. Soviet nuclear-powered submarines have unlimited range and may join an Atlantic battle even if normally deployed elsewhere. As is the case with Soviet aviation, the main routes of the primary Soviet submarine force that would threaten those lanes run from the Barents Sea via the Norwegian Sea into the Atlantic. Both land- and sea-based antisubmarine warfare (ASW) capabilities could be maximized by exploiting the geographic chokepoints that lie along this route, as well as erecting barriers at chokepoints that lie along routes to the Atlantic from nuclear-powered submarine (SSN) fleets in other parts of the world.

A key unit within the overall ASW system would be the attack submarine, which can be used in barriers at geographic chokepoints along the probable routes of Soviet submarines to the Atlantic. The present SSN force appears to provide sufficient units for these barriers. It also provides additional submarines for secondary missions worldwide such as area patrol, which is the primary mission of the land-based patrol aircraft, and convoy escort, the primary task of surface warships. Adding to SSN

missions, such as requiring submarines to escort all carriers, would require an increase in the SSN force level. It is uncertain whether SSN escorts for carriers would significantly enhance overall ASW capabilities, or would be required in situations other than those in which the carriers would pursue missions involving attacks on shore targets in heavily defended areas.

If the submarine force indeed were increased to provide escort protection for a minimum of ten carriers, its total force level would have to exceed 100 boats, a figure in excess of likely U.S. SSN force levels in the mid-1980s. A program to achieve this goal by the late 1980s would call for far higher submarine construction levels than have recently been envisaged. Whereas Secretary Rumsfeld called for eight SSNs to be authorized in fiscal years 1978-82, at a cost of $2.7 billion (in fiscal year 1978 dollars), an accelerated "CV Escort" SSN program would call for the construction of 25 submarines at a cost of $8.9 billion (in fiscal year 1978 dollars).

It would appear that, even with present missions unchanged, there is a need to add significantly to the surface escort force. Escort force levels have fallen far short of DoD goals, and modifications of total force requirements have not in themselves eliminated the gap between escort requirements and escorts available to the fleet. Even if no major new units were added to the fleet, and no additional convoys programmed for the early weeks of a European war, it might be necessary to undertake a significant construction program of at least 45 ships during the next five years in order to meet the demands presently placed upon the surface escort force. A program calling for the authorization of nine guided missile frigates (FFGs) in each of fiscal years 1978-82 would meet this requirement. This program is consistent with the present Administration request for authorization for nine FFGs for 1978; its total five-year cost would be $7.2 billion (in fiscal year 1978 dollars).

An alternative to this program would call for twelve FFGs to be procured in each of the five fiscal years 1978-82. This program would be consistent with Secretary Schlesinger's goal of 250 escort ships to support a potential increase in naval amphibious lift capability to 1-1/3 Marine divisions as well as an augmented underway replenishment force. The cost of this program would exceed $9.6 billion (in fiscal year 1978 dollars).

The patrol aircraft (P-3) force represents the major contribution of land-based aviation to antisubmarine warfare, especially in carrying out the task of area search for submarines. The P-3 force could search large areas of ocean daily, and exact gradual attrition of the enemy submarine force whether or not those submarines were to attack friendly forces.

Although the patrol role of the P-3 presently represents the primary contribution of land-based aircraft to ASW, there remains scope for further contributions, both by the P-3 and other land-based aircraft. One particular area in which land-based aircraft could play a crucial role is in the sowing of antisubmarine minefields. Creation of mine barriers could substitute for submarine barriers in certain areas, notably the North Atlantic. However, it is uncertain whether there presently exists sufficient airborne minelaying capacity to be dedicated to this mission.

CHAPTER I INTRODUCTION

Traditionally, major participants in the process of determining the size and structure of the Navy have tended to focus on "naval" means of accomplishing national objectives in the maritime arena. Alternative force programs have been propounded in the context of a self-contained naval requirement, one that rarely has accounted for the potential for maritime warfare that other forces might exhibit. Recent advances in technology, our system of alliances, and in particular the geographic location of our allies relative to our potential adversaries, make it possible, however, for ground- and land-based tactical air forces to contribute to the pursuit of maritime goals. Indeed, nonnaval forces acting in the maritime context may, in some instances, provide advantages in cost or effectiveness over more traditional naval alternatives.

This paper will address overall requirements for pursuit of the U.S. maritime mission of sea control. It will focus on operations in the North Atlantic region, since it is there that demands upon U.S. resources are likely to be most severe in a conflict with the Soviet Union and its Warsaw Pact allies. The paper will outline some of the ways in which both naval and nonnaval and sea-based and land-based resources could be used to exploit the geography of the North Atlantic region, particularly in support of the Allied anti-air and antisubmarine effort. Both of these aspects of sea control are critical to its success. The paper will seek to illustrate that the Soviet air threat probably is greatest in the early stages of a conflict, while the submarine threat will probably endure over a longer period, and thereby in turn will require a longer-term, sustained antisubmarine warfare (ASW) effort.

ORGANIZATION OF THE PAPER

"Sea control" is a term that is used widely to connote a variety of mission goals. This paper will first outline the effect of different conceptions of sea control upon naval requirements. It will then examine the importance of sea control in different scenarios, relating to a European conflict between the Warsaw Pact and NATO. Less attention will be devoted to the

requirements for maintaining sea control in non-European areas. These requirements may be considerable, particularly if the conflict with the Soviet Union is fought worldwide. Nevertheless, as noted above, it is the European context that the Department of Defense (DoD) deems most demanding upon U.S. resources, even if that context is but a part of a worldwide conflict. A focus on the Atlantic region will illuminate the choices among the kinds of contributions to the sea control effort that might allow the most efficient response to the Soviet threat.

Highlighting the Atlantic region, the paper will then address the two key aspects of the sea control mission noted above: anti-air warfare (AAW) and antisubmarine warfare (ASW). The discussion of anti-air warfare requirements will examine the deficiencies and possible improvements of the allied air defense environment in the Greenland-Iceland-United Kingdom (G-I-UK) gap. This region borders the critical sea-lanes between the United States and Western Europe. It forms a geographic barrier that must be traversed by Soviet air, surface, and submarine units based in northeastern Russia in order to attack allied shipping moving along those lanes. The ASW discussion will examine submarine and escort force requirements in the context of NATO's ability to exploit its geographic advantage by interposing ASW barriers between Soviet bases and allied shipping in the Atlantic sea-lanes. Because Soviet nuclear submarines have unlimited range, and could participate in an Atlantic war even if deployed elsewhere in the world, this section will focus on total worldwide requirements for U.S. ASW systems. Both the air defense and the ASW sections will discuss the interaction between geography and possible contributions to the North Atlantic sea control mission from nonnaval and non-sea-based systems, and outline alternative sea control-oriented programs for the fiscal year 1978-82 period.

CHAPTER II SEA CONTROL: DEFINITIONS AND ASSUMPTIONS

SEA CONTROL: A STANDARD DEFINITION

The Navy historically has tended to view sea control as primarily, if not exclusively, a Navy mission. Thus the Chief of Naval Operations introduced his fiscal year 1978 posture statement with the remark: "Sea control is the fundamental function of the U.S. Navy and connotes control of designated air, surface, and subsurface areas." In elaborating his definition, Admiral Holloway said that "control" is the "engagement and destruction of hostile aircraft, ships, and submarines at sea or ... the deterrence of hostile actions through the threat of destruction." 1/ In his view, "Maritime threats can be attacked and destroyed on the high seas or in their base areas." 2/ The latter form of destruction is termed "strategic sea control." 3/ "Tactical sea control," on the other hand, involves a battle in defense of the sea-lanes that takes place near them.

1/ Statement of Admiral James L. Holloway III, U.S. Navy, Chief of Naval Operations, before the House Committee on Armed Services, concerning the FY 1978 Posture and FY 1978 Budget of the United States Navy, 7 March 1977 (processed), p. 2 (hereinafter referred to as HASC Holloway Posture Statement).

2/ Statement of Admiral James L. Holloway III, U.S. Navy, Chief of Naval Operations, before the House Subcommittee on Seapower and Strategic and Critical Materials of the Committee on Armed Services, 23 February 1977 (processed), p. 1.

3/ HASC, Holloway Posture Statement, 7 March 1977, p. 12. The "power projection" mission, which connotes the Navy's ability to launch aviation from carriers, to provide firepower from naval guns, and to land Marines ashore, may be viewed as an aspect of "strategic" sea control. However, naval power can also be projected ashore in support of other friendly forces, as in the case of the Marine Corps Inchon landing during the Korean War.

92-129 O - 77 - 2

The Navy makes the purpose of this deterrence and/or destruction quite clear. The United States pursues a forward strategy. Its forces, and those of its allies, will need to be resupplied during a war and should be secured from attack by Soviet maritime forces. This can only be accomplished if the United States and other allied maritime units can thwart Soviet attempts to launch attacks on allied forces and to destroy allied shipping. However, the forces that perform this sea control mission need not be drawn exclusively from the U.S. Navy. Allied naval forces, and those of other U.S. services, can and do play important roles in sea control.

SEA CONTROL: CONTRASTING VIEWS

U.S. Navy discussions of sea control do not usually deal at length with the possible contribution of other forces to that mission. Sea control might be viewed, however, as purely a theater-oriented mission, calling for resources of all kinds, naval and others, that can help defeat a threat to the sea-lanes. Equally, sea control might be defined as the mounting of a combination of land- and sea-based resources to combat land- and sea-based threats to our maritime interests, whether these threats are near to or more remote from the sea-lanes themselves. Both of these notions of what the sea control mission requires go beyond conventional views that call for exclusively sea-based resources to meet all land- or sea-based threats to the maritime sphere.

A view that restricts sea control to theater warfare is perhaps too restrictive. There are elements of the sea control mission that affect more than the theater battle. For example, U.S. submarine barriers at geographic choke-points could play a role in reducing the level of the enemy submarine threat to any maritime theater. The U.S. submarines perform the sea control mission in its "strategic" sense. In assessing U.S. requirements for sea control forces, it is best to take account of all contributions from friendly forces. 4/

4/ The above discussion assumes a nonnuclear conflict, as does official DoD planning. A nuclear engagement at sea could, of course, result in severe damage to the U.S. fleet if the Soviets shot first. A strategy geared to attacking Soviet

SEA CONTROL IN NATIONAL STRATEGY

In the context of a worldwide war between the Soviet Union and the Atlantic allies, successful pursuit of the sea control mission would grow in importance as the duration of the war increased. In a short war, while the first convoys might be helpful to the allied effort, the bulk of the fighting would be done with allied men and equipment in place or delivered by air. Dependence on resupply would not be total, as it would be in a protracted war.

Assumptions about the length of a possible war, notably a war in Europe, are but one set of factors that affect requirements for pursuit of the sea control mission. Also important are assumptions about the length and nature of warning that might precede the outbreak of war. As noted above, even with several weeks warning, convoys are unlikely to arrive in Europe in significant numbers during the early weeks of the war. However, longer warning times would allow for measures to be taken that would improve the prospects for early and efficient protection of the sea-lanes. For example, ASW forces could be deployed to forward positions. Strategic base areas, such as Iceland, could be reinforced. And additional tactical aviation units, land- and sea-based, could be deployed in key areas, such as the North Atlantic, to withstand initial attacks from Soviet aviation on the first convoys transiting to Europe.

Lack of adequate strategic warning before the outbreak of war would preclude most of these deployments. Permanently deployed forces would be needed to blunt a surprise attack on maritime targets and key strategic locations, such as Iceland. These forces would have to emphasize tactical early warning and quick reaction capabilities. They might be naval forces, but could equally well be land-based either in the form of ground radars and air defenses or airborne early warning and interceptor aircraft.

---

bases or ports in the Soviet Union itself could lead to a Soviet nuclear attack upon U.S. forces. For further discussion about the risks attendant upon this approach, even in the context of conventional conflict, see Planning U.S. General Purpose Forces: The Navy, CBO Budget Issue Paper, December 1976, pp. 10-11.

The choice of the kind and amount of these forces clearly depends on assumptions about the nature of warning that might precede the outbreak of a European conflict.

Focus on the Air and Submarine Threat

The preceding discussion of the effects of warning time on sea control requirements has focused primarily on anti-air and antisubmarine warfare. The Soviet submarine force represents the most serious longer-term threat to allied use of the sea-lanes during wartime. Soviet Naval and Long-Range Aviation represent the key element of a surprise attack on allied maritime air and naval forces. Far less threatening is the Soviet surface fleet 5/, which is unlikely to venture far beyond the range-limited protection of Soviet Naval Aviation.

The following sections will focus on Soviet aviation and submarines as the key threats against which friendly forces must defend to ensure unrestricted use of the sea-lanes. Soviet aviation and/or submarines are deployed in, or within range of, the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea. They are thus in a position to disrupt the use of every major sea-lane leading to Europe and Japan. The most critical sea-lanes to Europe will be those along the North Atlantic from the United States from which military as well as economic support and supplies will emanate. For this reason, the following sections will examine anti-air and antisubmarine defense of those lanes, with special regard to the differing requirements of conflict preceded by short warning and that preceded by sufficient warning time to mobilize.

5/ Testimony of Admiral Holloway, in hearings before the House Appropriations Committee, Department of Defense Appropriations, Fiscal Year 1977, Part 8, 94-2 (1976), pp. 180-181. A possible exception is the Eastern Mediterranean, where the Soviets have deployed a large number of combatants that could inflict severe damage on the U.S. Sixth fleet if they shot first.

CHAPTER III. AIR DEFENSE IN THE NORTH ATLANTIC REGION: RESOURCES, DEFICIENCIES, AND REQUIREMENTS

Testifying before the House Appropriations Committee in July 1976, Admiral Holloway ranked Soviet Naval Aviation behind the submarine fleet but ahead of the surface fleet as a priority threat to allied control of key sea-lanes to Europe. 1/ While perhaps secondary, the threat from Soviet Naval Aviation nevertheless is hardly a minor one. Soviet Naval (and possibly Long-Range) Aviation possesses significant disruptive capabilities, particularly in the early stages of a war. Equally significant defenses are required to offset those capabilities.

SOVIET AVIATION: AN OVERVIEW

The Naval Air arm of the Soviet Navy presently numbers about 1,200 aircraft, 2/ of which about 645 are combat aircraft. 3/ The latter figure includes about 280 medium range (1,500-2,000 nm.) Badger bombers, armed with air-to-surface missiles with ranges of over 100 miles. It also includes at least 30 Backfire long-range bombers. 4/ The latter are estimated to have a combat radius of anywhere between 2,750 and 3,500 nautical miles (nm.), though it probably would be lower if the plane flew continuously at low altitudes or dashed long distances at supersonic speed. The

---

1/ Ibid. For an overview of Soviet capabilities in all three areas, see General George S. Brown, USAF, United States Military Posture for FY 1978, pp. 70-77 passim.

2/ Norman Polmar, "Soviet Naval Aviation," Air Force Magazine (March 1976) p. 69.

3/ International Institute for Strategic Studies, The Military Balance: 1976-1977 (London: IISS, 1976), p. 9. The Soviet Union also could employ its Long Range Aviation in a maritime role, see below, p. 8.

4/ The Military Balance: 1976-1977, p. 9.

Backfire carries two AS-4 missiles with ranges exceeding 100 miles. It is meant eventually to carry the AS-6 missile, with ranges reported up to 500 nm., 5/ though the optimally effective range will probably be considerably lower. 6/ More Backfires are expected to enter the Soviet Naval air force each year until a level of about 100 bombers is reached. 7/ As the Backfire level increases, that of Badgers is likely to decline, though perhaps not on a greater than one-for-one basis. Additionally, the total Backfire force level is estimated to reach about 400, with at least 300 planes expected to enter the Soviet Long-Range Aviation (LRA) force. 8/ Sea interdiction is a collateral mission for that force. Thus, while the magnitude of the Backfire threat should not be exaggerated, since the plane has other priority missions in its LRA role, it certainly is possible that more than just the Naval Air component of Backfire could be used to attack allied shipping.

The Naval Air Force also includes Beagle light bombers, short-range Blinder bombers, and bomber and reconnaissance variants of the long-range (8,000 mi.) Bear aircraft. 9/ These aircraft pose a secondary threat to NATO shipping and forces, particularly in areas near the USSR. A recent addition to the Soviet Naval Air arm is the force of Forger vertical/short take-off and landing (V/STOL) aircraft, presently deployed only aboard the

---

5/ Charles M. Gilson and Bill Sweetman, "Military Aircraft of the World," Flight International (March 5, 1977), p. 591.

6/ William D. O'Neil, "Backfire: Long-Shadow on the Sea-Lanes," United States Naval Institute Proceedings, CIII (March 1977), p. 30.

7/ Gilson and Sweetman, "Military Aircraft," p. 591.

8/ Ibid; O'Neil, in "Backfire," p. 30, cites CIA sources for this estimate.

9/ Polmar, "Soviet Naval Aviation," p. 71.

"antisubmarine" carrier Kiev. They are, however, also likely to be deployed aboard the Kiev's newer sister ships in the Kuril class as they enter the fleet. 10/

Not generally included in estimates of Soviet air capability in the maritime sphere are other Soviet tactical aircraft, such as the SU-19 Fencer, and the Mig-23 Flogger. The Fencer, a fighter carrying missiles with a range of about 50 nm., has an estimated combat radius of over 400 nm. 11/ Newer versions of this plane are predicted to have radii of about 1,000 nm. 12/ The Flogger also carries air-to-air missiles, though of somewhat shorter range. Its combat intercept radius is estimated at between 550 and 700 nm. 13/ At present, neither of these fighters has the range to enable it to escort Soviet bombers from their present bases to likely points of conflict along the northern air corridors from the Soviet Union to the North Atlantic ocean. These corridors extend through the Barents Sea north of the Kola Peninsula, around North Cape, and down through the Norwegian Sea between Iceland and Britain or through the Denmark Straits between Iceland and Greenland. Both involve transits in excess of 1,400 nm. However, these aircraft, if deployed from East Germany, could provide fighter escort for bombers across the Baltic and North Sea exits to the Norwegian Sea.

10/ House Armed Services Committee, Hearings on Military Posture and H.R. 5068 (H.R. 5970) and H.R. 1755, Part 4, 95-1 (1977), pp. 40, 51.

11/ Gilson and Sweetman, "Military Aircraft," pp. 577, 590. This assumes the Fencer flies at low altitudes throughout.

12/ Ibid., p. 590.

13/ Low estimate: Ibid., p. 577; high estimate, Georg Panyalev, "The MIG-23 Flogger--A Versatile Family of Soviet Combat Aircraft," International Defense Review, X (February 1977), p. 49.

DEFENSES AGAINST THE SOVIET AIR THREAT

Arrayed against the Soviet air threat to the sea-lanes are the interceptor forces of the United States (notably in Iceland), Britain, and Norway, which are positioned at critical points along the Soviet routes listed above. They are supported by a network (not totally integrated) of ground radars and early warning aircraft. Both the interceptor forces and the early warning systems vary widely in capability within the national forces and from one force to another.

Interceptor Capabilities

Norway represents the earliest opportunity for contact with Soviet aviation seeking to traverse the Barents-Norwegian sea route to the Atlantic. The Norwegian interceptor force numbers 16 F-104 interceptors as well as 75 F-5A fighter and 22 CF-104 attack planes that could be employed in the interceptor role. The Norwegian air force has contracted for delivery of 72 F-16 all-purpose fighter planes, to replace the F-104s, which are not considered to be highly capable against the most advanced Soviet fighters and bombers. 14/ The F-16 is considered to be a far more effective local air superiority fighter. It can achieve speeds up to Mach 1.8, and carries an improved radar as well as an improved version of the medium-range Sparrow missile. The F-5 does not match the F-16's capability, but it can supplement the F-16 interceptor force. Its combat range is approximately 500 nm., and it can carry Sidewinder infrared missiles.

The British Royal Air Force presently operates six squadrons (about 72 aircraft) of F-4 and Lightning interceptors in Britain. One more F-4 squadron is carried aboard the Ark Royal, which is due for retirement within the next three years. Britain has ordered approximately 165 air defense variant Tornados, the multi-purpose combat aircraft (MRCA) produced by a three-country consortium consisting of Great Britain, Italy, and West Germany. This plane will be armed with Skyflash medium-range missiles and Super-

---

14/ For comments on F-104 performance, see the testimony of Lt. General Alton D. Slay, USAF, in Senate Armed Services Committee, Hearings on S. 2965, Fiscal Year 1977, Part 9, 94-2 (1976), pp. 4838, 4839.

Sidewinder infrared missiles. 15/ Its range, speed, and combat radius should make it an effective counter to Soviet bombers approaching British air space. The Tornado should enter service in the early 1980s.

The British also plan to deploy an ocean-going version of their Harrier V/STOL plane, called the Sea Harrier, that, when used as an interceptor, would carry Sidewinder missiles. This plane would be deployed in small numbers aboard 20,000 ton, "through-deck" cruisers. Its combat radius is limited (380 nm.), however, and its service altitude does not approach that estimated for the Backfire.

The U.S. Air Force operates a squadron of 12 F-4C Phantoms from Keflavik airfield in Iceland. These planes are relatively old versions of the F-4 design; they had used an average of 81 percent of their aircraft life by the end of 1975, and were, on the average, 11 years old, considerably older than most other active U.S. fighter aircraft. 16/ Nevertheless, these planes have only recently replaced the Iceland F-104 force, while F-4Cs are, or have been, phased out of other Air Force active combat wings. They do not appear to be scheduled for replacement in the near term. These planes carry older versions of the Sparrow missile system, whose test results have been the subject of considerable criticism. 17/

Soviet planes seeking to exit from bases along the Baltic Sea, whether in the Soviet Union proper or in Poland or East Germany, would confront the interceptor forces of West Germany and Denmark, as well as those of Norway and Britain. The German naval air arm includes 85 F-104 fighter/bombers, which are geared

---

15/ Gilson and Sweetman, "Military Aircraft," p. 547.

16/ Information provided by U.S. Air Force to Senate Armed Services Committee (SASC), Hearings on S.2965, Fiscal Year 1977, Part 9, 94-2 (1976), p. 4878.

17/ Ibid., p. 5011.

primarily to the anti-ship mission 18/ but could provide some interceptor capability. The Danish air force includes two interceptor squadrons (40 planes) of F-104s and CF-104s.

In addition to the interceptor forces outlined here, other fighter planes, particularly U.S. forces, could be made available to offset the Soviet air threat. These could be transferred to the North Atlantic area from squadrons stationed in Germany or Britain, as well as from the United States. 19/ Additional interceptor capability could be made available from carrier task forces that would deploy to the North Atlantic. Each carrier carries two squadrons (24 planes) of interceptors. These are presently F-4s and F-14s; in the future, carrier forces will include either the F-14s, F-18s, or possibly by the late 1980s, a V/STOL interceptor. The utility of such transfers and alternatives to them will be discussed in a later section.

Early Warning Systems

NATO's primary system for early warning against an oncoming air threat is NADGE, the NATO Air Defense Ground Environment network. It is a system of 84 radar sites, together with electronic data transmission facilities, that links nine European countries, including Norway, Denmark, and Germany. The system also can control interceptor and surface-to-air missile assets. The radars vary in different countries; some have three dimensional tracking capabilities (height, azimuth, and range); others can track only in two dimensions (range and azimuth). Thirty-seven of the sites have data processing capabilities. All of the radars provide air defense against targets flying up to 100,000 feet. They are far less capable against low-flying targets, being

---

18/ General Sir John Sharp, "The Northern Flank," RUSI, Journal of the Royal United Services Institute for Defense Studies, CXXI (December 1976), p. 14.

19/ See comments below, p. 18, however, regarding the availability of aircraft for operation within the G-I-UK gap region.

only line-of-sight units. Additionally, many of the sites are vulnerable, since they are positioned on exposed hilltops and known locations. 20/

The U.K. Linesman system provides the early warning network for that country. It consists of three-dimensional radars and a sophisticated data transfer system. Linesman is linked to six NADGE stations. Given the rapid transferability of information within NADGE, it is possible for British air defense units to be forewarned of enemy approaches detected by Norwegian or Danish radars. 21/

There is no NADGE link to Iceland. Although that country does have some radar capability, its major long-range radar was destroyed by a storm in 1968, 22/ and its early warning capabilities presently reside primarily in the fleet of EC-121s deployed at Keflavik and described below.

Airborne Early Warning (AEW) Systems. The United States and the United Kingdom provide NATO's airborne early warning capability in the North Atlantic maritime sector. The Royal Air Force includes a squadron of 12 Shackleton aircraft that were converted to the AEW role. These planes are nearing obsolescence, and are scheduled for replacement in the near future.

The U.S. component of three EC-121 early warning aircraft stationed in Iceland is equally in need of replacement. These aircraft have seen, on the average, over 21 years of service life. Their systems are hardly equal to the variety of airborne threats embodied in the Soviet Naval Air Force, and their meager numbers prevent full-time airborne coverage.

20/ For further discussion of the NADGE system, see Jane's Weapons Systems, 1977. See also Major General John S. Pustay, USAF, and Major Dennis W. Stiles, USAF, "The E-3A Airborne Warning and Control System and Deterrance in NATO," NATO Review, XXIV (December 1976), p. 18.

21/ See Jane's Weapons Systems, 1977.

22/ Information supplied by Department of the Air Force in SASC, Hearings on S.2965, Part 9, 94-2 (1976), p. 4898.

IMPROVING NATO'S POSTURE IN THE NORTH ATLANTIC: ASSUMPTIONS AND CHOICES

NATO's air defense deficiencies in the North Atlantic region fall into three broad categories: the absence of an adequate early warning capability and the communications capacity to accompany it; the vulnerability of exposed airfields; and the absence of adequate interceptor capabilities throughout the region. Improvements in some or all of these areas, and choices between alternative means of improvement, depend on assessments of the nature of a war that would be fought there.

Three types of conflict are usually suggested for the northern region: a general European war preceded by some warning of Soviet intentions; a general war preceded by little or no such warning; or a rapid Soviet advance across the Finnmark area (see Figure 1), with the limited design of annexing that portion of Norwegian territory to the Soviet Union.

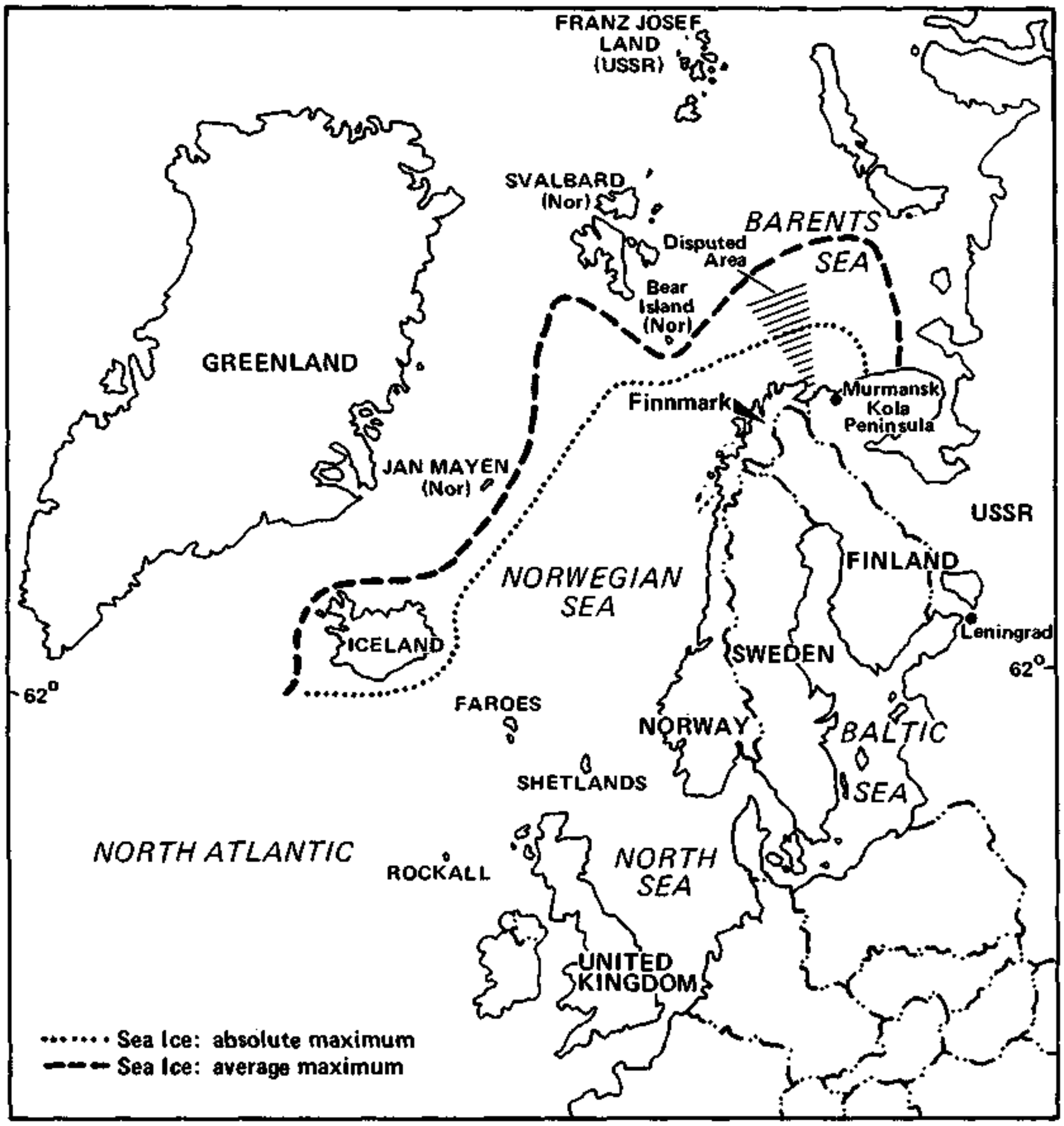
The attack on Finnmark alone seems a fairly remote possibility. Though the Soviets could gain much from such an attack--the use of airfields as well as the prevention of possible efforts by the Norwegians to mine the area north of the Kola Peninsula--the risks they would incur are even greater. The Soviets could not be sure about the nature and intensity of the allied response. They could not assume that the Allies, especially the United States, would accept a *fait accompli*. The local conflict could erupt into a general war. Even if it did not, the Soviets would run the risk of facing a hostile, unified and rearmed NATO alliance for some time into the future. On balance, the Soviets stand to lose more than they could gain by an isolated attack on northern Norway.

Contingencies involving a general European war may be as unlikely as an attack solely on Norway. They involve far more flashpoints for war to erupt, however, and they are far more demanding upon U.S. and allied resources. It is for that reason that they form the basis for DoD planning. These contingencies subsume the requirements for a localized Norwegian conflict, since a general Soviet attack could very well include an attack on Norway.

Clearly, each of these contingencies may be of longer or shorter duration. However, the length of the war does not really affect the need to improve the air defense shortfalls outlined above. A war of extended duration would require resupply of our

Figure 1.

The Soviet Pathway to the North Atlantic



SOURCE: Geoffrey Kemp, "The New Strategic Map," *Survival*, March/April 1977 (London: The International Institute for Strategic Studies).

NOTE: Stereographic Azimuthal Projection centered near Jan Mayen at N. Lat. 70°, W. Long. 10°.

SCALE: 485 miles to the inch.

deployed forces and, as a result, protection of the units providing the needed supplies. But deficiencies in early warning capabilities, airfield vulnerability, and lack of adequate interceptor capabilities could all be felt at the very outset of a war. Whether the war would be short or not matters less, then, than whether the Allies would have sufficient warning before its outbreak to remedy some of these deficiencies.

Consequences of a Short Warning Attack

The situation could be most serious if the Soviet Union were to launch a short warning air attack on Iceland. Low-flying aircraft could avoid detection by Norwegian radars. There would not be sufficient time to deploy a carrier to the area, unless one were on patrol in that vicinity. Similarly, it is unlikely that enough EC-121s could be transferred from the reserve force in Florida to Iceland in time to permit a full-time airborne early warning patrol. Iceland thus could suffer from an airborne attack with so little warning as to prevent optimum use of the limited capabilities of the F-4C squadron.

Soviet destruction of NATO defense facilities in Iceland could seriously affect the success of the sea control effort. It would permit the Soviets to utilize a wide aviation corridor for their bombers, without the deterrent of any interceptor capability on the island. While it is unlikely that the Soviets would stage an amphibious or airborne assault on Iceland itself, they could divert U.S. strength from the battle in Europe by forcing the deployment of ground forces to defend the Icelandic facilities.

Northern Norway is vulnerable to Soviet attack even if it has some warning of its neighbor's hostile intentions. Distances between Norway and Soviet bases in the Kola Peninsula are short enough to allow for Soviet destruction of a number of Norwegian airfields in the northern part of that country. These fields could also be seized by Soviet troops as part of a general attack on Western Europe. The Soviets deploy two first-line motorized divisions (27,000 men), as well as an amphibious brigade (4,000 men) and airborne units on the adjacent Kola Peninsula. They could form the advance units of an attack that might be reinforced either by additional airborne units or by ground attack troops, if the Soviets were prepared to divert them from the Central Front

region. 23/ It is possible, though not certain, that if the Soviets attacked with little warning, they could convert the seized airfields for their own use before U.S. carrier task forces and other units were able to reach the battle area. These fields could then serve as staging points for Soviet fighter escorts for the Naval Air bomber force, at least as far the Faroes Islands north of Britain. 24/

An early Soviet attack on southern Norway is a second possibility. Low-flying bombers, with fighter escorts from East Germany, could inflict heavy damage on key southern airfields that, like their counterparts to the north, are protected only by antiaircraft guns and older Nike-Hercules surface-to-air high altitude systems. Some observers have contemplated the possibility of Soviet amphibious landings along the southern Norwegian seacoast in order to ensure free air transit over southern Norway. The distances involved are quite long (about 1,000 nautical miles), however. The Soviet amphibious force, which is relatively small and not yet as modern or capable as its western counterparts, would be vulnerable to air attack. Nevertheless, destruction by air of the southern Norwegian bases could facilitate bomber operations from the Soviet Baltic ports into the Atlantic.

Responses to Warning Indicators of Soviet Intentions

Given some warning of imminent Soviet troop movements, the United States could deploy its reserve EC-121s to Iceland to supplement the current force and permit full-time patrol by at least one aircraft. With several weeks warning, carriers could

---

23/ See John Erickson, "The Northern Theatre (TVD): Soviet Capabilities and Concepts," in RUSI, CXXI (December 1976), p. 17.

24/ For further discussion of possible Soviet "pre-emptive" strategy in the Norwegian Sea region, see ibid., p. 19; Johan Jurgen Holst, "The Navies of the Super-Powers: Motives, Forces, Prospects," Power at Sea: II. Super-Powers and Navies, Adelphi Paper No. 122 (London: IISS, 1976), p. 11; Major General Toane Huitfeldt, "The Maritime Environment in the North Atlantic," Power at Sea: III. Competition and Conflict, Adelphi Paper No. 124 (London: IISS, 1976), p. 20.

also be deployed there, and the carrier-based E-2Cs could supplement the limited early warning capabilities of the older EC-121s.

The deployment of carriers would also bolster NATO's interceptor capabilities. Newer model F-4s and F-14s, flying on combat air patrol several hundred miles from the carrier, could provide a first line of defense against oncoming Soviet bombers. Additionally, Air Force fighters could be deployed to Iceland to augment the land-based interceptor force.

Nevertheless, even with considerable warning allowing a mobilization period of a few weeks, NATO faces some extremely difficult choices because of the insufficiency of its available resources. NATO must possess an adequate force posture on the Central Front to blunt the thrust of a Soviet attack. It must similarly provide adequate forces along the north German flank, especially Schleswig-Holstein, where as many as eight East German and Soviet divisions could quickly be deployed. It must provide for the defense and reinforcement of Norway. It must protect Iceland. And it can hardly ignore the balance along the southern flank, particularly in the Mediterranean. Within NATO, U.S. resources would play a considerable role in the preparations in each of these areas. These resources also are limited. Given the demands of the Central Front upon U.S. forces, it is uncertain that the Air Force could free significant interceptor assets for Iceland or Norway. Further, it would be difficult to free carrier resources, in the form of both early warning and interceptor aircraft, for the North Atlantic region.

There are at present 13 active carriers, including one that will soon be deactivated. Of the remaining twelve, one would probably be undergoing long-term service life extension (SLEP), if that program is approved in fiscal year 1978. Another two carriers probably would be in overhaul. Two more would be in the Mediterranean and four in the Pacific. There remain three active carriers in the fleet, with multiple demands for their capabilities. Reinforcement would likely be required in the Mediterranean. Additionally, demands for carrier aviation in the North

Atlantic could include support for transiting ships south of the G-I-UK gap, as well as support for Norway and Iceland. 25/

Clearly there would be a shortfall of available air defense assets in the North Atlantic even if a war were preceded by several weeks warning. The shorter the warning, the more serious the problem would be. Choices among different types of early warning as well as interceptor systems to be added to or redeployed within present forces will thus reflect different assumptions about the warning time available to the Atlantic Allies before the outbreak of war. The following section highlights alternative air defense postures in the North Atlantic in light of different assumptions about the length of that warning time.

25/ An additional requirement might be support along the southernmost route of convoys to Europe against possible residual threats from Soviet bombers exiting the Mediterranean or staging from Africa.

92-129 O - 77 - 3

CHAPTER IV. AIR DEFENSE IN THE NORTH ATLANTIC REGION: ALTERNATIVE PROGRAMS, FISCAL YEARS 1978-82

OPTIONS FOR A SHORT WARNING POSTURE

The importance of Norway, Britain, and Iceland to allied maritime strategy lies in their geographic location along the flight path from Soviet bases in the Kola Peninsula to the North Atlantic sea-lanes. In order to counter Soviet efforts to reach those sea-lanes, the Allies need to exploit the advantages that geography has afforded them. Tactical aviation in all three countries must be capable of defeating the Soviet air threat. If the Soviets were to attack with little warning, the air wings deployed in the area on a day-to-day peacetime basis would have to withstand the attack with little or no augmentation.

Clearly, immediate improvement of early warning capabilities is one major requirement. The present force of EC-121s in Iceland and British Shackletons is due to be replaced, though no time has been fixed for the replacement of either. Britain will probably replace its forces with Hawker-Siddley Nimrods. For the United States, the choices lie primarily in replacing the EC-121 force with the E-3A AWACS (airborne warning and control system), with the Navy's E-2C Hawkeye, with additional ground radars, or with carrier-based aviation. The United States also could act to improve Norwegian early warning capabilities to aid its G-I-UK effort through the augmentation of that country's ground radar sites.

It should be noted that U.S. political/military relations with Iceland have been strained in recent years. Indeed, in 1973, Iceland moved to expel U.S. forces from its territory. Relations improved soon after, due primarily to a change in the Icelandic Government which brought the Conservatives to power. The 1974 Icelandic-U.S. memorandum of agreement, which provided for a continued U.S. presence in Iceland, did, however, limit the total U.S. force level there and imposed severe constraints upon the stationing of U.S. personnel outside the Keflavik area. 1/ These

1/ "U.S. and Iceland Sign Pact on Keflavik Base," The Washington Post, October 23, 1974.

constraints, and the continuing possibility of deterioration in U.S.-Icelandic political relations, affect the choices that are available to the United States for improving its air defense posture on the island.

Improving Early Warning Capabilities

Ground Radar. As noted above, ground radar cannot detect and track low-flying aircraft or missiles. Simply placing additional ground radar in Iceland or Norway will not overcome this deficiency. If placed on an elevated location such as Norway's Jan Mayen island, ground radars could, however, prove to be extremely useful.

Two ground radars could also be placed in northern Iceland, in the northeast and northwest of the island. These would provide some high altitude early warning coverage, both of the Norwegian Sea and the entrance to the strait between Iceland and Greenland. Such an action would, however, have to overcome considerable political constraints as noted above. Although Iceland recently has improved its relations with the United States, its attitude to American presence on the island is still somewhat negative. There would be some resistance to the placing of American forces outside the Keflavik area to support additional radar installations. A negative Icelandic reaction on this issue could jeopardize the entire U.S. presence there.

AEW: E-3 AWACS or E-2C? Airborne early warning (AEW) would provide Iceland with low-altitude radar coverage without confronting the political problems associated with expanding the U.S. presence outside the Keflavik area. As noted above, both the E-3A and the E-2C could provide AEW coverage. The two planes are quite dissimilar, however, both in terms of their capabilities and their costs.

The E-3A is both a command and control and a long-range early warning plane. Originally intended as an airborne alert system against bomber attacks on the continental United States, AWACS now has been assigned the additional mission of supporting tactical air combat, primarily in Europe. Equipped with a long-range, "look down" radar, AWACS can track a large number of targets, both on land and water simultaneously. It thereby can provide command and control support for the tactical air force commands supporting ground combat operations along large portions of the Central Front. It also has considerable endurance. A modified Boeing

707, AWACS can remain on station for six hours, 1,000 nautical miles from its base. AWACS coverage and capabilities thus seem particularly suited to the G-I-UK gap. It could provide surface ship surveillance as well as track airborne targets. The Air Force has stated that it intends to replace its EC-121s in Iceland with AWACS "on a priority basis." 2/

However, AWACS is an extremely costly system. Unit procurement costs alone amount to $56.2 million (in fiscal year 1978 dollars). With a 17-man crew, and carrying extremely complex equipment, the operations and maintenance costs for each AWACS are high: $10.5 million annually.

The E-2C is a less capable plane than AWACS. It also has lower unit procurement and annual operating costs: $32.7 and $2.0 million, respectively. The E-2C is a carrier-based early warning plane. It is an updated version of the obsolescent E-2A and E-2B models. Its maximum range is nearly 1,400 nautical miles, but its endurance limits it to far smaller ranges in order to achieve several hours on station. Its cruising speed (269 nm. per hour) cannot match that of AWACS (in excess of 350 nm.) and, therefore, unless protected by fighters, is more vulnerable to enemy attack. The E-2C's radar is in some respects nearly as capable as that of the AWACS. It reportedly can survey at least 300 targets simultaneously at ranges over 200 miles. 3/ It is not, however, as capable as the AWACS in resisting enemy electronic countermeasures. Nevertheless, E-2C provides the Navy with an adequate carrier-based early warning aircraft that, on station, can detect threats several hundred nautical miles away.

However, early warning protection of the sea-lanes by an Iceland-based force is quite different from carrier-based early warning. The E-2C force on each carrier need not provide continuous long-term coverage on its own. Carriers frequently operate in tandem and can pool their E-2C resources. On the other hand, the E-2C force stationed in Iceland would have to provide continuous coverage, at longer range than carrier-based E-2Cs, against bombers that might seek to transit the G-I-UK gap at maximum

---

2/ Department of the Air Force reply to question of Senator Goldwater, SASC, Hearings on S.2965, p. 4898.

3/ Gilson and Sweetman, "Military Aircraft," p. 566.

distances from both Keflavik and British air bases. 4/ Even if modified to provide extended range for duty in the G-I-UK gap, the E-2C cannot provide coverage to match that of AWACS in both range and on-station time. For this reason, more E-2Cs than AWACS would be required to support a single continuous coverage orbit in the G-I-UK gap, and far more if equal distance from base were desired. This disparity in the number of aircraft required for long-range, continuous coverage in the Norwegian Sea partially offsets the lower unit cost of the E-2C. Table 1 indicates that the 15-year total cost of providing E-3A coverage at distances that would permit Iceland-based interceptors to attack bombers transiting the G-I-UK gap exceeds by 20 percent (or $13.3 million annually) comparable costs for AWACS coverage. It is possible, though uncertain, that the technical capabilities of AWACS are sufficiently superior to those of E-2C to fully offset that cost differential. 5/

Early Warning in the Baltic Area

As noted above, early warning in the Baltic is provided primarily by ground-based radar and British Shackletons. Newly AEW-configured Nimrods should provide a significant increase in

---

4/ The E-2C or AWACS would also be providing early warning coverage against possible bomber attacks on Iceland itself. Protection of the sea-lanes is the more demanding task, however, since sufficient early warning must be available to allow fighters to intercept as much as 350 nm. from Keflavik. An attack on the base itself would not require fighters to travel as far, and could support less warning time from AEW aircraft, thereby in turn making fewer demands on their range and endurance. Carrier-based E-2Cs operate approximately 200 nm. from the carrier. For further discussion of the relationship between interceptor capabilities and AEW requirements for sea-lane protection, see Appendix A.

5/ It should also be noted that estimates of E-2C costs incorporate the contractor's cost projections for an expanded-range E-2C, since the range of the current version is likely to be insufficient to support continuous patrol in the G-I-UK gap. No such modification has been undertaken, however, and its costs may be understated (see Appendix A).

TABLE 1. E-2C AND E-3A: COST OF MAINTAINING CONTINUOUS 30-DAY STATION, 450 FROM BASE, IN MILLIONS OF FISCAL YEAR 1978 DOLLARS

Plane	Total 15-Year Life Cycle Cost
E-2C (extended range)	981
E-3A AWACS	1,181

SOURCE: CBO Defense Resources Model, assuming a crew ratio of 2.0 for AWACS and 1.5 for E-2C. For the calculations regarding 450 nm. distance from base, assumptions underlying procurement, operating, and base support costs and the number of planes required to maintain continuous coverage, see Appendix A.

British capability to supplement the ground radars. Backfires would have to fly at low altitudes over the Baltic to evade ground radar. Nimrods, staging out of Britain, should provide enough warning against this slower, low-altitude Backfire threat to allow RAF forces sufficient time for interception.

The Choice of an Interceptor

As previously noted, a number of countries provide interceptor capabilities against Soviet air forces seeking to enter the North Atlantic ocean. Allied interceptor assets, particularly RAF Tornado interceptors and Norwegian F-16s, should provide adequate defenses against Backfire flights over the Baltic. On the other hand, while the United States possesses the most capable total force, its dedicated interceptor forces for maritime air defense in the North Atlantic are, paradoxically, among the least capable.

A replacement policy for the F-4C squadron in Iceland could take two forms. It could focus on force levels as well as aircraft, or it could consist merely of replacing the older aircraft with newer types. Clearly, the former policy is the more ambitious of the two.

At present, the Iceland Defense Force is a combined Navy and Air Force operation. The commander is a U.S. Navy Rear Admiral; his deputy is an Air Force Colonel. The Navy operates and supports P-3 surveillance planes and other facilities; the Air Force mans and supports the interceptors and early warning aircraft. Given the presence of a dual command at Keflavik, replacement interceptors for the F-4Cs could be operated by either service without serious alteration of the command structure.

As noted above, the 1974 Icelandic-U.S. memorandum of agreement has limited overall U.S. force levels in Iceland and prompted a more efficient organization of the base structure. The force of this agreement makes it unlikely that more than one interceptor squadron could replace the F-4Cs without causing political friction between the U.S. and Iceland over American base rights at Keflavik. 6/ A second squadron dedicated to the G-I-UK gap air defense mission might be required, however, to assure a credible deterrent against large bomber raids on Atlantic convoys. It would also be needed to support continuous combat air patrol operations out of Iceland during a crisis or wartime for both sea-lane defense and to improve the protection of the Keflavik base. This second squadron could be based in Britain, with a view to rapid (less than 48 hours) redeployment to Iceland in a crisis.

There are several types of aircraft that could form the replacement squadron for the F-4C in Iceland, as well as the second squadron in Britain. These are the Navy's F-14 interceptor, and the Air Force's F-15, F-16, and F-4E aircraft. The F-14 is the most capable Navy interceptor; its Phoenix system permits it to fire at six targets simultaneously. Two squadrons of F-14s would increase the present Iceland interceptor force's capability by at least a factor of four.

None of the three Air Force planes has a missile system that can match the Phoenix either in range or in number of shots that can be fired simultaneously. The F-4E is primarily a medium-

---

6/ The Icelanders appear more concerned about base manpower levels than about equipment levels. Additionally, sources familiar with the Icelandic situation are of the opinion that slight manpower level increases could be accommodated if they accompanied improvements of the force's capabilities.

term replacement alternative. As this plane is phased out of other Air Force units to make way for F-15s and F-16s, it could be made available for the defense of Iceland. It has essentially the same airframe as the F-4C, but several newer avionics systems.

Over the longer term, the choice of an Air Force alternative rests between the F-15 and the F-16. The former, while more expensive to procure, provides a more significant long-range, air-to-air missile capability that would be useful for the intercept of missile-carrying bombers. It has a more capable radar, is faster, and it carries the all-weather medium-range Sparrow air-to-air missile.

Sparrow could be added to the F-16's system, but only at great cost to its combat capabilities. In particular, the Air Force asserts that its range would be lessened by 28 per cent to that approximating the Harrier V/STOL aircraft. 7/ This range (about 380 nm.) would inhibit maximum U.S interceptor operations throughout the G-I-UK gap area.

The ultimate choice of an interceptor will very much depend on availability as well as cost. As Table 2 indicates, the F-4E would require no new procurement cost. The F-14 is more costly than the F-15. Both planes, which, unlike the F-16, have the full range of capabilities required for the interceptor mission in the G-I-UK area, are currently in production. Since, as noted above, there is no indication of early replacement for the F-4Cs in Iceland, providing either the F-14 or F-15 for their replacement may require an increase in the production programs for both planes. The immediacy of their availability for operations in the G-I-UK gap would then depend on decisions concerning their use in other locales. If air defense in other areas takes precedence over that in the G-I-UK area, the F-14s may not become available until about 1983, while F-15s may not be available until even later.

7/ Information provided to Congressional Budget Office by United States Air Force, May 5, 1977.

TABLE 2. COMPARATIVE INTERCEPTOR COSTS: TWO SQUADRONS, IN MILLIONS OF FISCAL YEAR 1978 DOLLARS

Type	Procurement		15-Year Operation		Total Cost
	No.	Cost	No.	Cost	
F-14 a/	57	1,154	24	504	1,658
F-15	41	656	24	504	1,160
F-4E	--	--	24	472	472

SOURCE: CBO Defense Resources Model.

a/ These figures are based on a combined F-14 pipeline, training, and attrition rate of 2.36 that is derived from data for a carrier-based plane. The size of a land-based F-14 force is likely to be lower, since the attrition rate will be lower, but its cost would still exceed that for an equivalent F-15 program (see Appendix A).

Protecting Interceptor Assets in Iceland and Norway

Improving Iceland's early warning and interceptor forces is crucial to successful defense against bomber attacks on allied shipping or on Iceland itself. Additional protection for the Iceland base could be obtained by constructing sufficient hardened shelters to house the two interceptor squadrons. The attendant base alterations are unlikely to cause political friction with the Icelandic Government since they involve no permanent increase in the U.S. force. 8/ On the other hand, at the cost of approxi-

---

8/ Adding Hawk batteries to the Iceland force would provide still more protection for the base. Doing so would result in additional manpower increases, however, and in the political tension that would most likely accompany them.

mately $10 million (in fiscal year 1978 dollars), the United States could significantly increase the Iceland Defense Force's survivability. 9/

As noted above, the threat to Norwegian assets is more immediate than that against Iceland. Given sufficient early warning and improved interceptor capabilities, a Soviet attack on Iceland could prove a very costly effort in terms of losses to the relatively small Backfire force. For example, if a force of 40 Backfires attacked Iceland, they could be met by a total of at least 12 ready-alert aircraft, including interceptors on combat air patrol. If these interceptors were F-14s, they would carry six Phoenix missiles each, in addition to their guns. Given present system capabilities, it would be likely that enough Backfires could be shot down initially to prevent the complete closure of Keflavik airfield, while far fewer than half the force would ultimately return to its base. 10/

The response time available to Norwegian fighters is much shorter than that for the Icelandic force. To enhance ground defense and help ensure that bases do not fall into enemy hands, it might be useful to augment Norwegian anti-aircraft capability. This presently consists of anti-aircraft guns. The United States could supply Norway, possibly on favorable terms, enough Hawk and Chapparal missile batteries to provide three or four key bases with defenses against medium-altitude missiles, such as those a Backfire could launch. 11/

9/ A lower cost alternative to building shelters would be the construction of revetments at a cost of approximately $12,000 each.

10/ An attack on Iceland is not, however, the most demanding contingency operation for the Iceland Defense Force. See above, page 24, footnote 3.

11/ The United States grants waivers on research and development costs when selling weapons to its NATO Allies. Norway could benefit from such a waiver on the improved Hawk missile. Further reductions could also be negotiated. See Foreign Military Sales and U.S. Weapons Costs, Congressional Budget Office Staff Working Paper (May 5, 1976), p. 5 and footnote 7.

Is the Aircraft Carrier a Solution to the AEW and Interceptor Problem?

As noted above, an enemy attack that was not preceded by any warning could probably be timed to avoid facing aircraft carrier forces in the Norwegian Sea or North Atlantic. Carriers could, however, be placed permanently on station in the area both to provide early warning of attack, as well as to provide interceptor assets to counter the Soviet air threat.

One forward deployed carrier, with two F-14 squadrons, eight E-2Cs, and other types of aircraft, could provide sufficient coverage for the Norwegian Sea gap between Norway and Greenland. The present carrier force could support this additional forward deployment if the Pacific fleet is limited to two carriers. 12/ If the Pacific fleet continues to be maintained at or near its present peacetime level of six carriers, with two forward deployed, it will be necessary to procure at least one more carrier as well as its associated air wing and a mix of air defense and ASW destroyer escorts, to support an additional forward deployment in the Atlantic. The mid-sized carrier (CVV), which the Carter Administration has included in its fiscal year 1979 naval shipbuilding request, could meet this requirement. The CVV, estimated to displace at least 50,000 tons, is programmed to carry 50-60 aircraft, sufficient for carrier air defense tasks in the G-I-UK gap.

The CVV is estimated to cost $1.25 billion (in fiscal year 1978 dollars). To the cost of this carrier and its air wing must also be added the cost of its escorts and replacement ships. Table 3 illustrates the operating costs of a carrier task group (CTG) assigned to the G-I-UK station, as well as the procurement costs of a CTG if Pacific forces could not be transferred in sufficient numbers for this task. In the former case, the 15-year

---

12/ With two carriers in the Pacific, one undergoing service life extension (SLEP), and two in overhaul, there would remain seven active carriers in the Atlantic fleet to support the two Mediterranean deployments and the additional deployment in the G-I-UK gap. For a discussion on the possible rationales for reducing the Pacific carrier force, see the forthcoming CBO Budget Issue Paper, Planning U.S. General Purpose Forces: Forces Related to Asia.

TABLE 3. THE CARRIER OPTION: PROCUREMENT AND 15-YEAR OPERATING COSTS FOR NON-NUCLEAR TASK FORCE, IN MILLIONS OF FISCAL YEAR 1978 DOLLARS

Type	Procurement Costs	15-Year Operating Cost
A. No Carrier or Escorts Procured		
Carrier (CV)	--	1,471.5
with air wing a/	327.6	2,269.5
3 Destroyers (DD-963)	--	510.0
2 Cruisers (CG-16/26)	--	609.0
TOTAL	327.6	4,860.0
COMBINED TOTAL	5,187.6	
B. One Carrier/5 Escorts Procured		
Carrier (CVV)	1,250.0	1,488.0
with air wing b/	2,221.9	1,566.0
3 Destroyers (DD-963)	743.4	510.0
2 AEGIS Destroyers (DDG-47)	975.0	522.0
TOTAL	5,190.3	4,086.0
COMBINED TOTAL	9,276.3	

SOURCE: CBO Defense Resources Model. For assumptions underlying all figures in this table, see Appendix A.

a/ Air wing consisting of: 24 F-14A; 12 A-6E; 12 A-7E; 10 S-3A; 4 EA-6B; 8 SH-2F; 4 KA-6D; 8 E2-C; 1 RA-5.

b/ Air wing consisting of: 24 F-14A; 10 S-3A; 4 EA-6B; 6 SH-3H; 4 KA-6E; 8 E-2C; 1 RA-7.

costs would amount to $5.2 billion (in fiscal year 1978 dollars). If a new carrier and escort had to be procured, the procurement cost of the group would total $5.2 billion, and its 15-year cycle cost $9.3 billion. Table 4 indicates that, even if sufficient carriers were transferred from the Pacific force to require no new carrier procurement, the cost of a carrier option would exceed that for land-based aviation.

TABLE 4. CARRIER OPTIONS AND ILLUSTRATIVE LAND-BASED AVIATION OPTIONS: COMPARATIVE COSTS, IN MILLIONS OF FISCAL YEAR 1978 DOLLARS

Option	Procurement/Base Alteration Costs	15-Year Operating Cost	15-Year Total Cost
AWACS/2 F-14 Squadrons	1,625	1,292	2,917
E-2C/2 F-14 Squadrons	1,877	839	2,717
No New Carrier Procured	328	4,860	5,188
Procure One Carrier/Associated Air Wing/5 Associated Escorts	5,190	4,086	9,276

SOURCE: CBO Defense Resources Model. For assumptions underlying all figures in this table, see Appendix A.

It is extremely difficult to compare the capabilities or effectiveness of the small land-based Iceland force with a large carrier air wing. The carrier option provides more aircraft than are likely to be available for operations in the G-I-UK gap if the aircraft are stationed in Iceland and supplemented by a squadron

in Britain. The key aircraft for the air defense mission, interceptors and early warning planes, appear in comparable numbers in both the land-based and carrier options, however. Other aircraft carried aboard the carrier, while useful in other contexts, may be somewhat superfluous to overall defense requirements in the G-I-UK gap. For example, even a small carrier air wing would include a complement of S-3 and SH-3 antisubmarine aircraft. These planes and helicopters would contribute marginally to the ASW effort, but hardly in a significant way, since the Iceland-based P-3 ASW patrol force already provides airborne antisubmarine coverage in the area. Similarly, while A-6 and A-7 attack planes might prove useful in North Atlantic operations, they do not appear to be critical for those operations if no attacks on land targets are contemplated. Thus, while a cost comparison clearly favors a land-based option, it is more difficult to ascertain the significance of an effectiveness comparison that appears to favor the carrier.

ALTERNATIVES FOR A LONG WARNING POSTURE

The alternatives outlined in the preceding sections all apply with respect to a scenario that assumes considerably more warning time before the outbreak of war. An additional alternative would be to maintain present force levels in the region.

As noted earlier in this paper, there is no certainty that, even if some warning were available to the Allies, sufficient resources could be made available to the North Atlantic area to counter the many contingencies that might arise there. At first glance, the problem of early warning capabilities seems the most manageable. Given advance notice of Soviet intentions, EC-121s could be transferred to Iceland to supplement the force already there. The augmented force could support one plane on permanent station. This would not solve the EC-121's problems of age, reliability, and inadequate radar, however. Even given notice of Soviet intent, there remains the question of exactly where Soviet planes would fly.

Carriers could be deployed from the United States (or the Mediterranean) to provide the early warning coverage. Two car-

riers could be sent into the Norwegian Sea, at some risk, 13/ to provide the coverage as well as a deterrent to Soviet actions.

These carriers will also be needed in other areas, the mid-Atlantic sea lanes, for example, where land-based aviation cannot provide sufficient coverage or protection against residual bomber threats. 14/ Reinforcement from the Pacific should, however, solve the carrier numbers problem, unless Atlantic and Mediterranean carrier forces were to sustain very heavy losses at the onset of hostilities. Given optimistic assumptions about the survivability of carriers and the number of Pacific carriers that could be released for operations in the Atlantic, the carrier might be the better choice for providing early warning and interceptor capabilities in the G-I-UK gap in a "long warning" scenario. To be sure, the cost of this option would exceed both the AWACS and E-2C options, since the operating costs of both carrier forces would total $9.5 billion 15/ and would be charged to the primary Atlantic mission. No change in present deployments would be necessary, however. Carrier forces could continue to provide a stabilizing presence in the Pacific, as well as a warfighting capability for non-NATO contingencies. Thus this option would actually provide for three missions, not one, including two different wartime missions in different parts of the world. Nevertheless, if one were to adopt a less optimistic view about carrier survivability, particularly in light of the large submarine force that the Soviets could deploy in the Norwegian Sea, there would again be a case for procuring additional carriers for the Atlantic force. In that case the choices and considerations would be the same as in the "short warning" context outlined in the preceding section.

13/ See Planning U.S. General Purpose Forces: The Navy, pp. 23-24.

14/ Two carriers would likely be needed to provide coverage for several convoys traveling along the sea-lanes to Europe.

15/ This figure is the 15-year cost (in fiscal year 1978 dollars) of operating two task forces, derived from the figure for one task force presented in Table 3.

CHAPTER V. ANTISUBMARINE WARFARE

The threat that Soviet submarines pose to allied shipping is of a longer-term nature than that posed by Soviet aviation. Soviet bombers could be utilized at the outset of a war to destroy allied forces and bases. They could form part of an attack launched with less than a week's warning. The Soviet submarine force, on the other hand, would seek to prevent the transit of ships bearing supplies from the United States to its forces and Allies in Europe. The demand for these supplies would grow with time, as prepositioned stockpiles were expended in the initial war effort. Similarly, the number of ships transporting supplies would grow with the prolongation of the war, as more convoys were organized in the United States. The effects of the Soviet submarine effort would thus be felt in the longer term, as cumulative attrition of convoy shipping would prolong and exacerbate shortages of war materiel and economic necessities in Western Europe.

Soviet submarines would not likely be a major component of a surprise attack in the Atlantic. Relatively few of them deploy there, and their deployment in numbers sufficient for sea-lane interdiction would itself be a critical signal of an impending Soviet attack. 1/

The allied antisubmarine warfare (ASW) effort, like Soviet sea-lane interdiction, depends upon cumulative attrition for its effectiveness. The Allies would seek to neutralize the Soviet submarine fleet by destroying submarines at a rate large enough to make the ratio of merchant ships sunk to submarines sunk appear unfavorable and costly to the Soviets. This might deter further Soviet attempts at sea-lane interdiction. Eventually, enough Soviet submarines would be sunk so that the remainder, even if they continued to harass trans-Atlantic shipping, could not seriously disrupt the resupply effort.

1/ See p. 38 below, and footnote 7. See also remarks of Congressman Les Aspin, Congressional Record, February 7, 1977, p. H913.

92-129 O - 77 - 4

THE SOVIET SUBMARINE THREAT

The task confronting the Allies is, however, a prodigious one. The Soviet Union possesses the world's largest submarine fleet, including 231 general purpose attack submarines. 2/ These are divided among the four Soviet fleets, the Northern, Black, Baltic, and Pacific fleets, with the largest number attached to the Northern fleet. This fleet, based in the Barents Sea and having year-round, ice-free access to the open ocean, poses the greatest threat to America's sea-lanes to its European Allies.

The Northern Fleet Submarine Force

The Northern fleet numbers 125 cruise missile and torpedo attack submarines, of which 47 are nuclear-powered. 3/ Recent estimates posit that by 1985 the total Soviet submarine force will rise from its present level of 84 nuclear-powered attack submarines (SSN) to about 165 SSNs. 4/ Given present proportions, the Northern fleet would claim about 92 of these. This number is larger than the present total U.S. diesel and nuclear attack submarine force. Nevertheless, these estimates may be conservative. They assume the continuation of current annual production rates of two submarines a year for each of the most modern classes

---

2/ IISS, The Military Balance, 1976-77, p. 9.

3/ Robert P. Berman, "Soviet Naval Strength and Deployment," Michael MccGwire and John McDonnell, eds., Soviet Naval Influence: Domestic and Foreign Dimensions (New York: Praeger, 1977), p. 324.

4/ Michael MccGwire, "Soviet Naval Programs," in ibid., p. 355. In contrast with MccGwire's projection for 1985, Barry Blechman has estimated that the total attack submarine force would reach 120 SSNs and 76 diesel submarines by 1980 (see Barry M. Blechman, The Control of Naval Armaments: Prospects and Possibilities (Washington, D.C.: The Brookings Institution, 1975), p. 88). This near-term estimate assumes a slightly higher building rate than MccGwire's projection does.

now under construction. The Soviets have the capacity, however, to produce as many as ten nuclear and ten diesel submarines annually. 5/

Submarines, particularly nuclear submarines, are formidable antiship and antisubmarine systems. Nuclear submarines have unlimited range and long-term endurance. For this reason, it is possible that the Northern fleet force could be supplemented by some of the 31 SSNs allocated to the Pacific fleet. The Pacific fleet's submarines would likely be needed, however, not only for interdiction of the Pacific sea-lanes, but also to protect the large number of strategic submarines and related facilities based in Soviet Asia. Submarines from the Soviet Baltic and Black Sea fleets would not likely play a significant part in a conflict on the high seas, since they probably would be caught in home waters at the beginning of a war. The exits from the Baltic and Black Seas are controlled by NATO Allies and could be shut off by mining and other ASW tactics.

Missions of the Northern Submarine Fleet. Like the Pacific fleet, the Northern fleet's attack submarines have a primary mission of protecting the fleet's strategic submarine force (50-55 SSBNs) 6/ in addition to their sea-lane interdiction mission. Such protection would take the form of ASW operations against allied submarines that might seek to attack the SSBNs. Northern fleet submarines also would be required for protection against carrier and amphibious forces that might conduct operations in the Norwegian Sea. The presence of a large number of Charlie-class cruise missile, nuclear attack submarines in the fleet testifies to the continued importance of this mission. The Charlie's short-range (30 mile) SS-N-7 missiles are well suited to operations against carrier task forces. While the Mediterranean is most commonly mentioned in connection with the Charlie's capabilities, the Norwegian Sea is an equally appropriate area for its operations.

5/ MccGwire, "Soviet Naval Programs," p. 342.

6/ See Robert G. Weinland, "The State and Future of the Soviet Navy in the North Atlantic," in MccGwire and McDonnell, ibid., pp. 406, 417. See also Robert G. Weinland, "The Soviet Navy and the North Atlantic Naval Balance," translation of "Die Entwicklung der Sowjetischen Kriegsmarine und das Gleichgewicht im Nordatlantik," Europa-Archiv (1977) (processed: December 1976), p. 14.

It is noteworthy that usual peacetime Soviet deployments seem to reflect the priority of protecting approaches to the Soviet Union rather than interdicting the sea-lanes. In general, the Soviets deploy only three or four attack submarines in the Atlantic area. 7/ These may be drawn from the Northern or Baltic fleets. Exceptions to these deployments, that is, the occasional deployment of more submarines, are associated with major Soviet exercises, Soviet responses to allied exercises, or to transits of relief groups to the Mediterranean Sea.

Clearly, the Northern fleet is large enough to release a significant Atlantic sea-lane interdiction force and still retain considerable capability to defend SSBNs and to conduct operations in the Norwegian Sea. Nevertheless, the fact that not all the Northern fleet's available submarines are likely to be utilized in sea-lane interdiction is important when assessing the requirements for conducting allied antisubmarine warfare.

U.S. ASW CAPABILITIES

The U.S. general purpose forces contain a large number of diverse antisubmarine warfare units, almost all of them under U.S. Navy command. These units fall into three separate categories--submarines, aviation units, and surface ships--but operate in conjunction with each other as part of a coordinated ASW effort. The United States has organized its assets in a pattern that forces Soviet submarines to run a gauntlet of ASW systems placed between submarine supply bases and their targets (whether they are convoys or carriers). In general, submarines are placed within barriers organized along geographic chokepoints at approaches to major seas and/or at exits from key Soviet bases. Patrol aircraft, such as the land-based P-3, conduct search sweeps in areas known for their concentration of submarines, and utilize sonobuoys to detect and localize them. Lastly, surface ships, as well as submarines, provide close in "point defense" for convoys or other high-value targets that might be attacked by submarines that evaded or avoided the chokepoints and area sweeps. This gauntlet pattern maximizes the probability that the submarine will approach and be detected by ASW sensors. Once detected, the submarines can be localized, attacked, and sunk.

7/ Weinland, "State and Future of Soviet Navy," p. 411.

Submarine detection and destruction is, however, an extremely difficult and time-consuming task. The properties of the ocean vary with both location and season, yielding uneven results when even an appropriate technology, such as sonar, is applied to submarine detection. Soviet nuclear submarines are capable of prolonged submergence, and can exploit the ocean's properties for their own protection. Soviet submarines are most likely to be detected when they approach predeployed fixed or submerged sensors, such as the SOSUS system in the Atlantic, or when they seek to pass through submarine barriers or attack convoys or carriers. On the other hand, random searches of vast ocean expanses historically have not resulted in significant levels of submarine destruction relative to the level of effort expended on these searches, and are unlikely to produce significant results in the foreseeable future. 8/ Nevertheless, even when a Soviet submarine approaches detection systems, the probability that it will be sunk is uncertain. The submarine might take evasive action, if it detects its potential attacker in time. It might even fire before its attacker can. The detection systems might fail; so might the fire control systems that activate the torpedo or antisubmarine rocket (ASROC) that would seek out the submarine. Even if the attack were successful, the submarine might not be destroyed. The submarine might successfully return to its base, or at least transit beyond the reach of the sensors it initially approached, and the process of detection would then have to begin afresh.

The gauntlet system should ultimately reduce the active Soviet submarine force level to proportions that could not impede the movement of convoys across the Atlantic. For example, one study cites official projections that between 70-90 percent of the Soviet submarine force could be destroyed within the first three

---

8/ While detection methods and systems have improved significantly since World War II, so too has the capability of the submarine. The historical record is unlikely to be altered in the next decade (see George R. Lindsey, "Tactical Anti-Submarine Warfare: The Past and the Future," Power at Sea: I. The New Environment, Adelphi Paper No. 122 (London: IISS, 1976), pp. 37-39).

months of a European war. 9/ That same study notes, however, that the process could not be significantly accelerated by adding more of the systems we now possess. Since it is the gradual accumulation of a large number of probabilities for destroying submarines, the gauntlet process simply takes time. 10/

It should be noted that all ASW activities worldwide would be important to the allied effort in the event of a war in the Atlantic. Given the ability of Soviet nuclear submarines to cover long distances, all systems--submarines, frigates, and patrol aircraft--could conceivably play a role in an Atlantic war. Additionally, without submarine barriers as well as other ASW activity, hostile submarine operations against U.S. Pacific forces could impede their possible transfer to the Atlantic. Thus ASW force requirements must be assessed on a worldwide basis, even if the main combat theater is assumed to be the Atlantic area.

Force Requirements for U.S. ASW Systems

Sizing the Submarine Force. The present (end of fiscal year 1977) U.S. attack submarine force consists of 10 diesel and 65 nuclear-powered submarines. An additional 27 SSNs have already been authorized by Congress, and should enter the fleet by 1981. At that time the total attack SSN force will stand at 82 boats, most of them of the 637- and 688-classes.

As noted above, the submarine force already includes the new 688-class, which is said to be quieter than previous types. Its quietness enables it to gain better performance from its BQQ-5 sonar. The 688 is equipped with the Mark 48 acoustic homing torpedo, with a range of about 50,000 yards. The combination of

---

9/ Dave Shilling, "A Perspective on Anti-Submarine Warfare," reprinted in Senate Budget Committee, Hearings: First Concurrent Resolution on the Budget--Fiscal Year 1978, 95-1 (1977), p. 242.

10/ Ibid., p. 244. See also the discussion of requirements for ASW in Alain C. Enthoven and K. Wayne Smith, How Much is Enough?: Shaping the Defense Program: 1961-1969 (New York: Harper and Row, 1971), especially pp. 225-229.

torpedo, sonar, and quietness affords the 688 a considerable advantage for securely detecting and destroying enemy submarines well before it can itself be detected.

U.S. nuclear attack submarines are well suited for barrier operations in the Norwegian and Barents Seas, which Soviet Northern fleet submarines must traverse to reach the Atlantic. Other places where barriers would be useful are at the entrance to the Mediterranean Sea and the exits from the Sea of Japan. As noted above, because of the ability of Soviet submarines to transit long distances, all could participate in an Atlantic war. Allied submarine barrier stations worldwide would, therefore, affect the course of combat in the Atlantic area.

Barrier operations have been for some time the primary determinant of the "first-line" submarine force. During the later MacNamara years, 11/ it was determined that a total of 60 first-line submarines was the required SSN force level, presumably to man the barriers. The remaining nuclear-powered submarines (about four) and diesel-powered submarines were to be available for other missions, presumably area search, convoy escort, and antiship operations. The size of the desired overall force level was unclear. Secretary MacNamara pointed out that he initially wished to preserve the total force at 105 boats, 12/ implying that at least 40 diesel submarines would remain in the force. But no diesel submarine building program was undertaken, and it was clear that by the fifth year of his last five-year program (that is, fiscal year 1973) the diesel force probably would number no more than 25 boats. The implied total force level, including the first-line SSNs, thus probably was no more than 90 submarines.

MacNamara's successor, Clark Clifford, expressed deep reservations about the adequacy of the 60 first-line SSN force. He stressed that there should be no pause to the SSN construction program; he wished to encourage new developments in submarine technology and promote their rapid incorporation into the subma-

---

11/ Robert S. MacNamara, The Fiscal Year 1969-73 Defense Program and the 1969 Defense Budget (January 22, 1968), p. 123.

12/ Ibid., p. 124.

rine force. To this end he underlined the importance of adding the 688-class to the SSN force, and called for a higher first-line force level goal. Though he did not specify what that goal should be, Clifford did add substantially to MacNamara's submarine construction program. Clifford's proposal for three SSNs to be authorized in fiscal year 1970 and four in each of the following four fiscal years represented an increase of 11 SSNs over MacNamara's program for the fiscal year 1970-73 period. Clifford also noted that DoD planned to retain sufficient diesel submarines in the force to maintain a force level of 105 boats; however, he did not propose construction of new diesel submarines to replace older ones. 13/

Clifford's posture statement offered little rationale for the magnitude of the proposed SSN force increase, other than a vague statement about the growing Soviet threat. In fact, U.S. submarines were acknowledged to be superior to their individual Soviet counterparts, and were expected to retain that superiority into the 1980s. It was on the basis of that superiority, and in light of maximum submarine capabilities within fixed ocean areas, that MacNamara had determined submarine force levels for individual barriers, and thereby reached his total first-line requirement. Adding more submarines to those barriers was expected to add little to total barrier capability. Clifford did not refute this analysis, but seemed to ignore it. His Republican successors adopted his view, not MacNamara's, and continued to add to the nuclear submarine force.

The growth of the nuclear submarine force coincided with the retirement of a large number of diesel submarines. As noted above, MacNamara had called for a total force of 105 boats, though in practice it seemed unlikely that his program could sustain a total force of more than 80-90 nuclear and diesel submarines. Neither Clifford nor Melvin Laird altered the 105 submarine goal. By the end of fiscal year 1974, when the number of diesel submarines had shrunk to about 24 and the SSN force stood at 60, Elliot

---

13/ Clark M. Clifford, The 1970 Defense Budget and Defense Program for Fiscal Years 1970-74 (January 15, 1969), pp. 95-96. See also Melvin R. Laird, Fiscal Year 1971 Defense Program and Budget (February 25, 1970), pp. 144-145.

Richardson stated, however, that the total force requirement could safely be lowered. He implied that nuclear-powered submarines could replace diesel subs on a less than one-for-one basis. 14/

By the end of fiscal year 1975, the Navy had 64 SSNs delivered to the fleet, more than MacNamara's first-line requirement of fiscal year 1969, which had never been seriously challenged in public. With the prospect of the remaining diesel submarines retiring from the force, Secretary Schlesinger called for a total force of 90 SSNs. Both he and his successor, Donald Rumsfeld, who accepted that force level 15/, noted the tasks that were assigned to submarines in addition to barrier duty, namely area search, antiship operations and escort duties, which required the excess number over MacNamara's 60. Both continued the 688 program that Clifford initiated. Including Rumsfeld's proposals for fiscal year 1978, this program would result in an authorized force of 33 SSN-688s and a total SSN force of 86 boats by 1985. Secretary Brown lowered the proposed fiscal year 1978 authorization for submarine procurement from two to one. His proposals thus would result in an authorized force of 85 SSNs, including 32 of the 688-class.

Are More Submarines Needed? As noted above, SSNs can perform a variety of tasks related to sea control, notably barrier duty, area search, antiship operations, and escort protection. It is unlikely that more than 60 submarines presently are required for barrier duty in the Atlantic and elsewhere. The U.S. SSN force has increased its margin of capability over the Soviet force since the days of MacNamara's analysis. The 637-class, authorized in the 1960s, is superior to its second generation Soviet counterparts, the Charlie and Victor classes. 16/ The new 688-class

---

14/ Elliot L. Richardson, Annual Defense Department Report, FY 1974 (March 29, 1973), p. 86.

15/ HASC, Hearings on Military Posture and H.R. 5068 (H.R. 5970) and H.R. 1755, Part 4, 95-1 (1977), p. 205.

16/ Vice Admiral R.J. Long, USN, stated to the Seapower Subcommittee in ibid., p. 174: "Based on our present understanding of Soviet capabilities, the 637 will remain a superior weapons system for the immediate future." His statement clearly

represents still a third generation of American submarine, one that is quieter than its predecessor 637-class and more effective as a submarine hunter. The Soviets, on the other hand, have yet to produce more than a few of the prototypes of their third generation submarines, which are said to be quieter and faster than the second generation Victor and Charlie classes. 17/

It is true that, as noted above, the Soviets have the capability to expand their submarine force significantly within a few years. Nevertheless, although they have maintained both nuclear and nonnuclear submarine construction, in contrast to U.S. production of SSNs only, the Soviets have permitted their total force to decline appreciably since 1960. Additionally, while the size of their Northern fleet submarine force has increased by 25 percent, that increase has been due largely to the introduction of additional ballistic missile submarines rather than more of the attack variety. 18/

Clearly, even if the Soviets do rapidly increase their annual submarine force production, and even if they actually do undertake serial production of a third generation submarine type (or types), second generation submarines will continue to constitute the majority of their force for some time to come. U.S. 637-class submarines will, therefore, embody a capability superior to that of a majority of the Soviet submarine fleet for a corresponding period, while the 32 688-class SSNs already authorized for construction will enhance the overall margin of superiority already enjoyed by the United States.

Given the absence of Soviet production in large numbers of a third generation submarine; given, too, the relative stability of

---

implies the continued superiority of this class over updated versions of Soviet second generation Charlie and Victor class submarines, whose delivery is assumed to have begun in 1973 (MccGwire, "Soviet Naval Programs," p. 339).

17/ See K.J. Moore, Mark Flanigan, and Robert D. Helsel, "Developments in Submarine Systems, 1956-1976," in MccGwire, ed., Soviet Naval Influence, pp. 174-76; see also MccGwire, "Soviet Naval Programs," p. 340.

18/ See Weinland, "State and Future of Soviet Navy," p. 407.

Soviet building programs and submarine force levels in the North Atlantic; and lastly, given the unchanging nature of the width of geographic chokepoints which provide the context for U.S. submarine barriers, it appears that the requirement for SSNs on barrier duty--the key sea control contribution of the submarine force--will grown no larger than 60 for some time to come. The tenor of posture statements since 1968 supports this observation. As noted above, procurement of additional SSNs appears to have been motivated by a need to replace older, less capable, diesel submarines, rather than to add submarines for barrier duty.

Requests for additional submarines, therefore, respond to requirements for submarines in nonbarrier duties. Apart from being assigned to the submarines already authorized and not required for the barrier role, these duties are also assigned to other ASW elements. Area search is the primary mission of the patrol aircraft, such as the land-based P-3 and carrier-based S-3. Aircraft patrol at greater speeds and can cover a wider area than an equivalent number of submarines.

Similarly, the antiship mission is not exclusive to the submarine. It is, rather, the primary mission of carrier attack planes. Furthermore, the addition of the Harpoon missile system to surface fleet capabilities will provide those ships with an antiship weapon that can be launched beyond the range of equivalent Soviet systems.

Lastly, convoy and carrier escort are the primary tasks of frigates and destroyers. Submarines cannot replace these ships, since they possess an anti-air capability that is also required for convoy protection and that submarines cannot provide. In effect, assigning submarines to the convoy escort role is another way of adding a barrier to the gauntlet. Adding towed array sonar and helicopters to the escort force, in a manner for which the FFG-7 class guided missile frigate is currently being programmed, also creates a new barrier. The towed array/helicopter combination could operate as an integral unit at distances beyond the range of hull-mounted sonar and shipborne torpedo antisubmarine rockets (ASROC).

The submarine could add some marginal capability to the close-in protection of convoys. That capability would supplement the enhanced ASW effectiveness of frigates, whose procurement would, in any event, be necessary to provide air defense for the

convoys. It is unclear whether the addition of a submarine barrier would provide sufficient effectiveness to be commensurate with its costs.

It can be argued that submarines do play a secondary role in carrying out missions other than barrier duty at geographic chokepoints. Proposals for adding to an SSN force level that already provides a full SSN complement for barrier coverage 19/ as well as at least 20 SSNs for these secondary missions, would, however, have to be justified by the addition of new missions for the SSN. Secretary Schlesinger's fiscal year 1976 posture statement noted one such mission, that of carrier escort. Were two submarines provided as escorts for each carrier, 20/ a minimum of 23 more would be needed to provide an operational force of two escorts for each of the ten carriers that would not be in overhaul. Thus a total of 103 SSNs would be needed in the force, given the requirement for 60 barrier SSNs and 20 SSNs for other missions.

If the program to provide two SSN escorts each for ten carriers indeed is undertaken, its total procurement cost would exceed $8.9 billion (in fiscal year 1978 dollars). The life cycle cost of this additional force would exceed $19 billion. Table 5 illustrates a possible five-year program and associated costs for achieving a total SSN level that would include this additional escort force.

It should be noted that Schlesinger's fiscal year 1976 posture statement, while addressing the possibility that submarines could serve as convoy escorts, also observed that they could only

---

19/ It is possible that fewer than 60 SSNs may be required for barrier duty. The deep water CAPTOR mine, which consists of an encapsulated torpedo, may prove to be more cost/effective as a barrier in certain areas, such as the G-I-UK gap. (See Richard L. Garwin, "The Interaction of Anti-Submarine Warfare with the Submarine-Based Deterrent," K. Tsipis, A. Cahn, and B. Feld, eds., The Future of the Sea-Based Deterrent (Cambridge, Mass.: MIT Press, 1973), p. 104.)

20/ Two submarines is a minimum estimate for the SSN escort role. As many as four SSNs could be utilized to escort each carrier.

TABLE 5. ALTERNATIVE SSN CONSTRUCTION PROGRAMS: SSN "CV ESCORT" PROGRAM VS. RUMSFELD FIVE-YEAR PLAN, FISCAL YEARS 1978-82 (IN MILLIONS OF DOLLARS)

	1978	1979	1980 (Number of Ships/Cost)	1981	1982	Total	Est. 1986 Total SSN Force a/
Current Dollars							
Rumsfeld Budget	2/510	1/530	1/540	2/780	2/740	8/3,100	86
"CV Escort" Program	4/1,190	5/2,120	5/2,220	6/2,540	5/2,150	25/10,230	103
Constant Fiscal Year 1978 Dollars							
Rumsfeld Budget	2/510	1/490	1/480	2/650	2/580	8/2,710	86
"CV Escort" Program	4/1,190	5/2,000	5/1,960	3/2,110	5/1,680	25/8,940	103

a/ Assumes six-year gap between Congressional authorization and commission in the fleet.

do so if they could coordinate their activities with other ASW units. Given the nature of submarine activities and the difficulties inherent in sonar detection, such coordination would not be easy to achieve.

A more fundamental question that would have to be answered with respect to such protection would be the nature of carrier operations. The value of adding still more protection to a carrier that in turn is meant to be providing area protection for convoys is considerably more problematical than the value of providing such protection to carriers seeking to attack land-based targets. In the former case, the asset that is ultimately being protected is the convoy, which already benefits from a series of ASW as well as anti-aviation barriers. Adding to the protection of the already well-protected carrier would provide only the smallest margin of additional protection to the convoy. 21/ Adding to the protection of the carrier when it is in an exposed position while attacking targets on shore in a very high threat area is of far greater value, particularly as the carrier might draw the Soviet SSN force from other antiship missions. Even in this case, given the carrier's present ASW defenses, which include SSNs at chokepoints, land-based P-3s, carrier-based S-3s, and ASW surface escorts, the margin of added protection might well be quite small.

Sizing the ASW Escort Level. As noted above, the prime role of ASW escorts is that of point defense for surface ships seeking to transit the sea-lanes. Since the late 1960s, estimates of the total escort force requirement have been primarily a function of ASW, and, to a lesser extent, anti-air warfare (AAW) requirements for protecting four different types of force units: carriers, amphibious assault groups, underway replenishment groups, and

---

21/ The carrier provides one part of a chain of "kill" probabilities against aircraft and submarines that attack a convoy. To measure the value of adding more ASW protection to the carrier, the marginal protection (i.e., the additional probability of carrier survival) must be multiplied by the chain of conditional probabilities for protecting the convoy. This will result in a very, very small percentage in most cases.

convoys. These groups do not necessarily operate at similar times or in similar scenarios. Convoys, for example, are only likely to be formed during a major war, notably one fought in Europe, and more of them will be formed as the war continues. The other three types of forces conduct peacetime operations, and could be employed in contingencies other than a long war. It is because these forces operate during peacetime that escort requirements for them take precedence over those for convoy protection. Indeed, convoy operations are stated to require less capable escort forces because they involve protection of relatively slow-moving ships in special formations against residual threats that have survived other barriers. Thus reserve warships, Coast Guard cutters, and allied warships have been included in force sizing exercises for convoy protection operations. 22/

The total required U.S. escort force level, as postulated by successive Secretaries of Defense, has declined significantly since January 1968, when Robert MacNamara publicized the ASW/AAW-linked methodology for estimating that level. MacNamara himself set no specific level in his posture statement, though he implied that it could be lower than the total of 296 cruisers, destroyers, and frigates that were in the active fleet at the end of fiscal year 1968. He later set that number at 231 active ships, and Clark Clifford adopted that figure with only the marginal addition of eight ships to escort an extra antisubmarine carrier. 23/

No change apparently was made to the overall requirement until 1974, when James Schlesinger outlined a new requirement for a total of 250 ships, including reserve and Coast Guard forces. 24/ This total reflected the decline in the forces to be protected, particularly the phasing out of the antisubmarine carrier

---

22/ See MacNamara, 1969 Defense Budget, p. 126; James R. Schlesinger, Annual Defense Department Report, FY 1975 (March 4, 1974), p. 126.

23/ Clifford, FY 1970 Defense Budget, p. 97.

24/ Schlesinger, Annual Defense Department Report, FY 1975, p. 126.

(CVS) units and the reduction in carrier forces. It was not, however, a product of any change in approach to the escort force sizing problem: escort requirements were still framed in terms of the fleet's overall ASW needs. In particular, it was not a result of methodology based on the ASW analyses described above, which showed that improvements in systems were more cost/effective for the ASW effort than additions to them. The escort levels postulated by MacNamara, and slightly modified by his successors, appear to have been the base for ASW operations. It was only in terms of increments to those levels that MacNamara's studies showed additional escorts to be less cost/effective than other ASW programs.

The required escort force level apparently continues to stand at about 250 ships, of which about 210 would be active warships. Schlesinger stated that these forces were sized to protect 12 carriers, ten underway replenishment groups, lift shipping for 1-1/3 Marine divisions, and five military convoys. Donald Rumsfeld altered the list of protected forces, noting that 13 carriers and "15 convoys at a minimum" required escorts, but did not alter the overall force requirement. 25/

The present active escort force is estimated to decline to to 171 cruisers, destroyers, and frigates by the end of fiscal year 1977. There is clearly a shortfall in escort-type ships, even if Schlesinger's lower estimate of assets to be protected is adopted. An even lower estimate, calling for escorts for 12 carriers, five convoys, and a lift capacity of only one-plus Marine divisions, still results in a 198-active ship requirement, as part of a 240-ship U.S. force 26/ or a present shortfall in excess of 26 ships. Any plans to increase the carrier force level, or to augment additional convoys to areas other than Europe, would simply add to the escort requirement, and to the current shortfall. 27/

25/ Donald H. Rumsfeld, Annual Defense Department Report FY 1977 (January 27, 1976), p. 164.

26/ See U.S. Naval Force Alternatives, pp. 73-75.

27/ For a discussion of carrier force requirements in a "power projection" Navy, see Planning U.S. General Purpose Forces: The Navy, pp. 46-52. There is a possible convoy and escort

Two programs are being proposed currently for escort construction. The first, the AEGIS 28/ destroyer program, is primarily geared to carrier escort requirements relating to operations in high-threat areas. To the extent that DDG-47 destroyers (or, indeed, other types of new AEGIS ships) are added to the fleet, the cumulative shortfall will decline. By the time DDG-47s enter the fleet in significant numbers, for example, by 1987 when the fiscal year 1978-82 program is fully realized, a shortfall of 45-60 ships will still remain even if no new carrier construction is undertaken (see Table 6).

This shortfall could be reduced by continuation of the second major escort construction program proposed for fiscal year 1978, the FFG-7 program. The FFG-7 is designed to escort units other than carriers. Together with the DD-963, a 7,200-ton ASW destroyer suitable for carrier escort duty, the FFG clearly is envisaged as the mainstay sea control escort for the 1980s and 1990s. 29/

The FFG-7 is a moderately capable, multipurpose ASW/AAW unit that is programmed to carry towed-array sonar, two ASW helicopters, and a launcher for Harpoon antiship missiles or Standard surface-to-air missiles. When operating in conjunction with other ASW and AAW units, the FFG should provide adequate protection for the residual threats that could approach convoys and other lower-value maritime assets.

The fiscal year 1978 Ford Budget requested funds to procure 11 FFGs. The Carter Administration has reduced the fiscal year 1978 FFG request to nine ships. If nine FFGs were bought in each

---

requirement for supporting Japan in a NATO war. Little public light has been shed on the size of either requirement. This paper assumes that convoy and associated escort force levels only address the need to support Europe in a NATO war.

28/ AEGIS is a rapid-reaction air-defense system capable of countering a multiple missile air attack.

29/ It has sometimes been argued that increasing the purchase of DD-963s is preferable to buying more FFGs for the ASW/AAW effort. This issue is discussed in Appendix B.

TABLE 6. ESCORTS: SHORTFALL AND CONSTRUCTION PROGRAMS

Schlesinger Requirement			Modified Requirement		
I. REQUIREMENTS					
Forces	Escorts		Forces	Escorts	
12 carriers (6 CVN, 6 CV)	60		12 carriers (4 CVN, 8 CV)	68	
Amphibious Lift (1-1/3 MAF)	60		Amphibious Life (1+ MAF)	56	
10 Underway Replenishment Groups	60		7-8 Underway Replenishment Groups	46	
5 Military Convoys	70-75		5 Military Convoys	70	
Subtotal	250-255		Subtotal	240	
Less Reserves/Coast Guard	- 42		Less Reserves/Coast Guard	- 42	
TOTAL	208-213		TOTAL	198	
II. SHORTFALLS					
	Escorts	Aggregate Shortfall		Escorts	Aggregate Shortfall
Schlesinger Requirement	213	--	Modified Requirement	198	--
FY 1977 (actual)	171	32	FY 1977 (actual)	171	26
FY 1987 (est.)	145	68	FY 1987 (est.)	145	53
III. PROGRAMS					
Shortfall (from above)	68		Shortfall (from above)		53
Less 8 DDG-47	- 8		Less 8 DDG-47		- 8
FFG Requirement	60		FFG Requirement		45

SOURCE: Derived from force projections in U.S. Naval Force Alternatives, pp. 67-75.

of the five fiscal years 1978-82, in addition to the eight DDG-47s proposed in the Ford budget and thus far not modified by Secretary Harold Brown, the total 1987 force level is likely to stand at 198 active ships, sufficient for the lower requirement total force level of 240 ships that was outlined above. Purchasing 12 FFGs a year would enable the Navy to attain the Schlesinger requirement of 213 active escorts and about 250 overall. This purchase might be justified on the grounds that Schlesinger's calculations assumed a 1-1/3 division Marine Amphibious Force that would be achieved in the mid-1980s when the five helicopter carrier/amphibious assault ships (LHA) are completed. As Table 7 indicates, the cost differential between the 9- and the 12-ship per year program is about $400-500 million for each of the five years. The total five-year cost of an FFG program that is geared to realizing stated U.S. escort requirements would range between $7.2 and $9.6 billion (in fiscal year 1978 dollars), depending on which of the two building rates were adopted. The cost of the fiscal year 1978 program would total at least the $1.3 billion called for in the Brown budget. 30/

TABLE 7. ALTERNATIVE FFG PROGRAMS, FISCAL YEARS 1978-82, IN MILLIONS OF DOLLARS

	1978	1979	1980	1981	1982	Total
45-Ship Program						
(9 FFGs Annually) a/						
Current Dollars	1,310	1,611	1,667	1,782	1,885	8,255
Constant 1978 Dollars	1,310	1,495	1,453	1,468	1,468	7,194
60 Ship Program						
(12 FFGs Annually) a/						
Current Dollars	1,746	2,148	2,220	2,376	2,514	11,006
Constant 1978 Dollars	1,746	1,994	1,936	1,957	1,958	9,591

a/ Excludes outfitting and post-delivery costs.

30/ It should be noted that sufficient shipyard capacity exists for an annual construction program of 12 FFGs. See U.S. Naval Force Alternatives, pp. 48-52.

Land-Based Aviation as an ASW System. As noted above, land-based P-3 antisubmarine warfare aircraft form an integral part of the gauntlet that every submarine must encounter between its home base and its target. The latest version of this plane, the P-3C has a cruising speed of 328 knots, and a patrol speed of 206 knots. Its endurance exceeds twelve hours, permitting it to maintain three hours on station approximately 450 nautical miles from its base. The P-3C can carry up to 87 sonobuoys for detecting submarines, as well as four Mark 44 torpedos, two depth bombs, and other ASW weapons. It also carries magnetic anomaly detection equipment, to determine the exact location of submarines by means of changes they cause to the magnetic field above the water's surface. It also has the capacity to analyze and store the magnetic as well as electronic and sonic data it receives. 31/

The P-3C is, therefore, especially well-suited to area searches for submarines over large stretches of water, since such searches require both endurance and an independent capability to detect the submarine. Additionally, because it is an airborne vehicle, there is an extremely low probability that the P-3 will be detected by its target, even if it flies directly above it. This fact in turn forces the enemy submarine to take precautions to avoid the P-3, and thereby complicates its own tactical problems.

In general, P-3Cs will search areas that are known or expected to have high concentrations of enemy submarines. In the North Atlantic, such areas are likely to include the approaches to the G-I-UK gap, which form probable Soviet submarine transit routes to and from bases in the Kola Peninsula. P-3s can also serve as area escorts for North Atlantic convoys, searching for submarines in large tracts of ocean at considerable distances from the convoy group. The squadron of P-3Cs stationed at Keflavik is best situated for the former mission, while the latter could be carried out by squadrons of P-3s flying from other bases in the Atlantic.

In both the general area search mission and the area escort role for convoys, P-3 forces could be supported in a NATO war by carrier-based S-3s and the forces of several other Allies. The

---

31/ For a fuller description of the P-3C, as well as other ASW aircraft employed by the Allies and outlined below, see Jane's All the World's Aircraft, 1976-77.

carrier-based S-3s and the forces of several other Allies. The British operate 5 squadrons (43 aircraft) of maritime reconnaissance Nimrods. These planes have range and endurance characteristics similar to the P-3C, though without equivalent computer processing capability for their sonobuoy information. The Canadian Air Force operates four maritime patrol squadrons with 26 CP-107 aircraft and one squadron of 13 CP-121 aircraft, which are less capable than the P-3. However, the Canadians have ordered 18 P-3Cs, designated CP-140, which will have the same capability as the U.S. version. Both the Canadian and British forces could operate in the convoy escort role, as well as that of broad area search. Additional land-based support for the area search mission, for regions north of the G-I-UK gap, is available from the small (5 planes) squadron of P-3Bs operated by the Norwegian Air Force.

Though the P-3's primary mission is area search, it can carry out several secondary sea control tasks. The P-3 is capable of carrying six CAPTOR (encapsulated torpedo) ASW mines. It therefore can play a useful role in any effort to create barriers of antisubmarine mines in the chokepoints of the North Atlantic region. Indeed, this mission may grow in importance as CAPTOR becomes operational in large numbers during the next decade. P-3s also can contribute to the antiship mission, since they can carry the Harpoon antiship missile. Though P-3s do not have defenses against Soviet surface-to-air missiles, Harpoon affords them the possibility of shooting at Soviet ships outside the range of shipboard defenses.

The P-3C, though a Navy system, epitomizes the type of contribution that nonnaval, land-based systems can make to the overall ASW effort. Unlike land-based early warning and interceptor aircraft, which can substitute for sea-based aviation in the North Atlantic area, P-3s are a complement to sea-based ASW in that region rather than a substitute for it. P-3s do not benefit from the stealth and unlimited endurance of SSNs; they are vulnerable to attacks by enemy fighters; they are not as efficient as helicopter-carrying escorts in providing rapid-reaction defense for convoys. Nevertheless, because P-3s possess unique capabilities for area search, in addition to the potential to carry out other types of ASW tasks, they will continue to be a key component of the total ASW network, complicating the navigational and tactical calculations of enemy submarines.

CHAPTER VI. CONCLUSION: UTILIZING NONNAVAL MEANS IN PURSUIT OF MARITIME ENDS

The sea control mission is a critical element of U.S. forward strategy. Sea-lanes to Europe will have to be defended against possible Soviet air, surface, and submarine attacks if timely and sufficient supplies are to reach our Allies and our forces deployed there. A variety of systems is necessary to provide this protection. These systems should exploit the advantages that geography has provided the United States and its Allies against the Soviet Union. These advantages could provide the alliance with strategic warning of Soviet intent, with tactical warning of the nature and direction of Soviet attacks, and with the ability to restrict Soviet forces, notably submarines, to operating areas that would maximize their encounters with allied ASW and air defense forces.

Sea control requirements cannot be defined in terms of the capabilities of any one military service. They are a function of the capabilities of enemy forces and the context in which those forces are employed. In order to protect sea-lanes to Europe, U.S. forces have to interdict Soviet forces as they approach those sea-lanes. The major route for both Soviet aviation, which constitutes the most immediate threat to the Atlantic sea-lanes, and Soviet submarines, which represent the longest-term threat to those lanes, begins at the Kola Peninsula and traverses the Norwegian sea to the Atlantic. The Greenland-Iceland-United Kingdom gap lies athwart that route and provides a natural base for supporting airborne early warning and interception of enemy bombers, as well as a staging point for maritime patrol aircraft that would search for enemy submarines in or near the gap. Additionally, it is possible to station attack submarines in the gap, or at other critical geographic chokepoints along the submarine route from the Soviet Union to the Atlantic. Thus geography provides the United States and her Allies with an opportunity to enhance the effort to protect shipping in the Atlantic by utilizing both sea-based and land-based forces to encounter attacking units before they reach the Atlantic sea-lanes.

The greatest immediate potential for capitalizing upon the possibilities that geography affords to the use of land-based aviation in sea control is with respect to the air defense mission. Present U.S. defenses against bomber attacks on the Atlantic sea-lanes reside primarily in a force based in Iceland that presently is deficient in early warning and interceptor capabilities, and is vulnerable to a short warning attack. While carriers could compensate for these deficiencies, it is questionable whether they could deploy to the North Atlantic in time to prevent Soviet destruction of the Iceland base. Additionally, it is uncertain whether enough carriers could be spared from other missions to provide for a permanent carrier presence in the G-I-UK region. If they could not be made available, new carriers would have to be built if a permanent presence is desired. In either case, however, enhancing Iceland's land-based defenses would provide a significant deterrent to, and defense against, Soviet bomber strikes in the Atlantic or on the island itself, at lower cost than either carrier option.

The antisubmarine warfare effort already incorporates land-based aviation as part of a system of complementary units that form a gauntlet which enemy submarines must cross between their bases in Russia and their targets in the Atlantic. A key unit within the overall ASW system is the attack submarine, which can be used in barriers at geographic chokepoints along the probable routes of Soviet submarines. The present SSN force appears to provide sufficient units for these barriers. It also provides additional submarines for secondary missions such as area patrol, which is the primary mission of the land-based patrol aircraft, and convoy escort, the primary task of surface warships. Adding to SSN missions, such as requiring submarines to escort all carriers, would require an increase in the SSN force level. It is not clear, however, whether SSN escorts for carriers would significantly enhance overall ASW capabilities, or would be required in situations other than those in which the carriers pursue missions involving attacks on shore targets in heavily defended areas. The emerging ASW technology of towed array systems and helicopter attack vehicles for surface escort ships might afford them comparative advantage in the close escort role, for carriers as well as for convoys.

It would appear that, even with present missions unchanged, there is a need to add significantly to the surface escort force. U.S. escort force levels have fallen far short of DoD goals, and provision for Allied escort contributions and modifications of

total force requirements have not in themselves eliminated the gap between U.S. escort requirements and escorts available to the fleet. Even if no major new units are added to the fleet, and no additional convoys are programmed for the early weeks of a European war, it may be necessary to undertake a significant construction program during the next five years in order to meet the demands presently placed upon the surface escort force.

As noted above, the P-3 force represents the contribution of land-based air to antisubmarine warfare, especially in carrying out the task of area search for submarines. P-3s possess the speed, sensors, and endurance that make them unique systems for meeting the demands of area search. The P-3 force could search large areas of ocean daily, and exact gradual attrition of the enemy submarine force whether or not those submarines were to attack friendly forces.

Although the patrol role of the P-3 presently represents the primary contribution of land-based aircraft to ASW, there remains scope for further contributions, both by the P-3 and other land-based aircraft. 1/ One particular area in which land-based aircraft could play a crucial role is the sowing of antisubmarine minefields. P-3s, B-52s, and C-5s all are capable of sowing CAPTOR mines. Creation of CAPTOR barriers could substitute for submarine barriers in certain areas, notably the North Atlantic. It is uncertain, however, whether there presently exists sufficient airborne minelaying capacity to be dedicated to this mission. Further analysis is necessary to determine how many planes would be needed to sow a sufficient number of mines in an area such as the G-I-UK gap during a predetermined period, in order to establish the exact nature of the airborne minelaying requirement.

1/ The Land-based Multipurpose Naval Aircraft (LMNA) has been put forward as a follow-on to P-3, as well as an airborne platform capable of performing various sea control missions. See Appendix C for a brief analysis of the LMNA proposal.

92-129 O - 77 - 5

APPENDIXES

APPENDIX A. OPTIONS FOR AIR DEFENSE IN THE G-I-UK GAP: THE CARRIER TASK FORCE VS. LAND-BASED AVIATION

CALCULATING LAND-BASED AVIATION REQUIREMENTS

AEW Requirements

Airborne early warning (AEW) aircraft are meant to provide sufficient advance warning of attacking enemy aircraft to permit friendly fighters to leave their bases and intercept them. In the case of the G-I-UK gap, the United States would have to provide interceptor capability against planes flying either between Greenland and Iceland, or up to 350 nm. east of Iceland. The British, who have announced their decision to acquire Nimrod AEW aircraft as well as MRCA interceptors, could be assumed to provide cover for the remaining 225 nm. of the Iceland-UK gap, which includes the entire gap from the Shetland Islands to the Faroes.

In a-short warning situation, as many of the Iceland-based planes as possible would be on ready alert, with pilots occupying quarters near to the aircraft. The most demanding situation for U.S. AEW aircraft would be one in which enemy supersonic Backfire bombers sought to transit the G-I-UK gap at high altitude 350 nm. east of Iceland. To be effective, the AEW aircraft would have to detect the Backfires at sufficient distance for interceptors (assumed, for illustrative purposes, to be F-14s) to achieve intercept. Their required range is derived from the minimum time required for friendly aircraft to achieve that intercept. This response time is the sum of the time required for a pilot on ready alert to enter his plane, and for the plane to start, climb, and reach the enemy target. The required range equals the response time multiplied by the speed of the enemy aircraft.

The time required for an interceptor to reach a target 350 nm. from base may be stated as:

$$T_i = T_p + T_{sa} + T_c + \frac{D_i}{V_f}$$

where T_i = Time required for intercept

T_p = Time required for pilot on alert to enter plane

T_{sa} = Time required for start of plane on strip alert

T_c = Time to climb (in this case to assumed Backfire altitude of 40,000 ft.)

D_i = Intercept distance

V_f = Speed of interceptor (in this case, assumed to be F-14)

Given an interceptor speed of Mach 2, which, at 40,000 feet is 19.17 knots per minute, and an intercept distance of 350 nautical miles, T_i = 28.26 minutes. Given T_i, one can then find the required early warning distance, since

$$EWD = \sqrt{(T_i \times V_B)^2 + D_i^2}$$ 1/

where EWD = Early Warning Distance

T_i = Time required for intercept (as above)

V_B = Speed of attacking aircraft (in this case, assumed to be Backfire)

D_i = Intercept distance (as above)

Thus, given the intercept time of 28.26 minutes, an assumed Backfire speed of Mach 1.75 2/, or 16.77 knots per minute at 40,000

1/ It is assumed that the angle of intercept is a right angle, since this corresponds to the minimum distance that an interceptor would have to travel to meet a crossing target.

2/ Estimates of Backfire speeds when carrying two air-to-surface missiles range as low as Mach 1.5. (Gilson and Sweetman, "Military Aircraft," p. 591.)

feet, and a 350 nm. intercept distance, the required early warning distance (EWD) equals 590 nm.

Both the E-3A and the E-2C have highly capable radars that can detect relatively small aircraft at distances in excess of 200 nm. An estimated early warning station of 450 nm. allows for the possibility of degraded radar capabilities under jamming similar to that which might be expected from the Backfire force. 3/

The number of aircraft required to maintain a continuous 30-day station 4/ at 450 nm. from base depends upon the endurance of the plane in question. Although endurance frequently is directly provided, it can be derived from other parameters:

$$E_e = T_s + 2\frac{s}{V_e}$$

where E_e = Endurance of the early warning plane

T_s = Time on a given station, s

s = Distance to a given station

V_e = Speed of the early warning plane

Given the plane's endurance, one can then obtain the plane's time on station from the same calculation by substituting 450 nm. for s. The number of planes required for continuous coverage is then

---

3/ The AWACS radar is more capable of resisting jamming than that of E-2C. This analysis does not consider that difference. However, it should be noted that to the extent that AWACS radar is indeed more resistent to jamming, AWACS can maintain a warning range equal to that of E-2C at a patrol station closer to base than 450 nm. The difference in patrol station might result in a lower AWACS force requirement and, in turn, lower costs for the AWACS program.

4/ A continuous 30-day station would permit early warning during a prewar crisis as well as the first weeks of war, when the air threat would be greatest and reinforcements, if necessary, might not be available.

derived from the relationship between the plane's endurance, its time on station, and its monthly utilization rate:

$$F_e = \frac{E_e \times 720}{T_s \times U_e}$$

where F_e = Required force of early warning planes for continuous station

E_e = Endurance of the early warning plane

T_s = Time on a given station, s

U_e = Monthly wartime utilization rate in hours per month of the early warning plane

and 720 represents the number of hours in each month

E-3A Requirements and Costs

Requirements. As noted in the text, five AWACS are required to maintain a continuous 30-day station, 450 nm. from Iceland. This number represents a rounded number, based on the calculations outlined above. The plane's endurance was derived from Air Force statements about the plane's 6-hour on-station time at 1,000 nautical miles, as well as estimates of its speed and monthly wartime utilization rate.

The Air Force has announced that a pool of AWACS will be maintained at Tinker Air Force Base, Oklahoma, that will provide the training and overhaul replacement units for the entire AWACS force. 5/ Two additional planes are procured to allow for that part of the training overhaul and attrition aircraft in the Tinker force attributable to the Iceland squadron.

Costs. E-3A unit procurement costs are estimated at an average unit cost of $56.2 million. This figure is based on the

---

5/ Statement of General Robert J. Dixon, USAF, in SASC, Hearings on S.2965, Part 9, p. 4935.

savings associated with the reduction of the fiscal year 1978 AWACS program. Annual operating costs are estimated at \$10.5 million (in fiscal year 1978 dollars). 6/

The total cost of the E-3A force is therefore:

$$LCC_f = C_p\ (N_p) + C_o\ (N_o)\ (15)$$

where LCC_f = Life cycle cost of the force

C_p = Unit procurement cost

N_p = Number of planes procured

C_o = Unit operating cost, E-3A

N_o = Number of operational aircraft

and 15 = Years of active operational life

These totals amount to

$$LCC_f = 56.2\ (7) + 10.5\ (5)\ (15)$$

$$LCC_f = \$1{,}181 \text{ million}$$

E-2C Requirements and Costs

Requirements. The E-2C in its present form does not have sufficient endurance to maintain a station of 450 nm. from base for as much as two hours. This on-station time hardly is worth the effort of several hours transit. For the E-2C to have sufficient endurance to maintain a station at 450 nm. from its base, it will be necessary to provide it with additional fuel-carrying

---

6/ These costs are based on peacetime utilization rates. While the force level is a function of wartime rates, it is nevertheless true that in peacetime the operating tempo will be much lower. The force would only have to provide continuous coverage in a crisis/war situation. (Source: CBO Defense Resources Model).

capacity. The Navy has indicated that with this "wet-wing" modification, the E-2C could have an on-station time of 7.2 hours at 200 nm. These parameters, together with estimates of the E-2C's speed and monthly wartime utilization rate, can be applied to the equations above, and yield a requirement for 11 E-2Cs for continuous surveillance at a station 450 nm. from base.

Unlike AWACS, there is no central pool of E-2Cs to cover training, attrition, and pipeline requirements. The total AAI (Authorized Active Inventory) requirement may be derived by multiplying the 11 E-2C force by the force level factor that reflects the present Navy program. For the E-2C, this factor is 1.73, based on a Navy purchase of 83 E-2Cs for 48 operational aircraft. 7/ The total E-2C procurement requirement would now total 19 planes, to support the 11-plane force in the G-I-UK gap.

Costs. E-2C unit procurement costs were assumed to be $33.2 million. This is a combined figure. It includes the average unit procurement cost of the present E-2C over the next five years, which is an estimated $32.7 million, as well as the estimated recurring cost of the wet-wing modification, $0.5 million. The unit operating costs of the E-2C are assumed to be $2.033 million annually.

There will also be additional nonrecurring costs associated with the procurement of wet-wing E-2Cs. These are estimated to total $15 million.

The total cost of the E-2C force is therefore:

7/ This factor probably overstates the attrition factor for the land-based E-2C since attrition is higher for sea-based aircraft than it is for land-based planes.

$$LCC_f = C_p\ (N_p) + C_o\ (N_o)\ (15) + C$$

where LCC_f = Life cycle cost of the force

C_p = Unit procurement cost

N_p = Number of planes procured

C_o = Unit operating cost

N_o = Number of operational aircraft

C = Nonrecurring wet-wing modification costs

and 15 = Years of active operational life

and these totals are

$$LCC_f = 33.2\ (19) + 2.033\ (11)\ (15) + 15$$

$$LCC_f = \$981 \text{ million}$$

F-14 Requirements and Costs

The force level for the F-14 was determined by the number of F-14s required for interceptor duty in the G-I-UK gap, multiplied by a force level factor to account for planes in overhaul, and training and attrition aircraft. Based on the Navy's projected purchase of 509 aircraft to support 18 squadrons of twelve planes each (216 aircraft), that force level factor is 2.36. Thus for an additional 24-plane operational force, the maximum total required force is 57 planes. 8/

8/ It is likely that pipeline, training and attrition aircraft associated with an additional squadron will be lower than projected in this appendix, since it would have land-based, rather than sea-based attrition factors. The 2.36 figure assumes an attrition factor for sea-based aircraft. However, it should be noted that even if the F-14 had the same attrition factor as the F-15, and required only a 41-plane program to support two squadrons, it still would be more expensive,

It was assumed that F-14s would be procured at an average cost of \$20.2 million, in fiscal year 1978 dollars, per unit. The annual unit operating cost of the F-14 is assumed to be \$1.4 million, in fiscal year 1978 dollars. 9/ An additional cost associated with basing F-14s in Iceland would be that required to establish intermediate maintenance facilities there. The Navy has estimated a cost of \$79.9 million.

The total cost to support the F-14 force is therefore:

$$LCC_f = C_{pf} (N_f) + C_{of} (N_{of}) (15) + C$$

where LCC_f = Life cycle cost of the force

C_{pf} = Unit procurement cost per fighter

N_f = Number of fighter planes procured

C_{of} = Unit operating cost per fighter

N_{of} = Number of operational fighter aircraft

C = Initial base modification expenditures

and 15 = Years of active operational life

For the F-14, these totals would be

$$LCC_f = 20.2 (57) + 1.4 (24) (15) + 79.9$$

$$LCC_f = \$1,735 \text{ million}$$

Calculating F-15 Requirements and Costs

The F-15 force level, like that of the F-14, is assumed to total 24 operational planes. Based on a factor of 1.69 (the ratio of the 1977 programmed purchase of 729 planes to the requirement

---

costing \$1,412 million to \$1,160 million for the F-15. See Table B and the discussion of F-15 costs on page 70.

9/ Source for these figures is the CBO Defense Resources Model.

for six wings of 72 planes each), there is a procurement requirement of 41 planes to support the 24 plane force.

Calculations of the F-15's costs utilize the same formula as in the preceding section. 10/ The average unit cost of an F-15 is $16 million; its annual operating cost is $1.4 million.

CALCULATING CARRIER TASK FORCE REQUIREMENTS AND COSTS

The "No Carrier Procurement" Option

Task Force Requirements. As was indicated in the text, 11/ a reduction in Pacific forces would allow for an additional carrier deployment in the Atlantic. Given the relatively short distances between the G-I-UK gap and points at which the task force could refuel, nuclear propulsion is not critical to the carrier's successful operations, and it is assumed that the task force will be conventionally powered. The escort force is assumed to consist of two Terrier air defense cruisers, one each from the CG-16 and CG-26 classes, and three DD-963 ASW destroyers. 12/

The carrier's air wing is assumed to be a sea control air wing, similar to that outlined in the CBO study Planning U.S. General Purpose Forces: The Navy. 13/ The only adjustment to the wing is the procurement of ten additional E-2C airborne early warning aircraft, to support one full-time AEW station for 30 days

---

10/ The calculation assumed $79.9 million for base modification costs, as with the F-14. Since this figure is a Navy estimate for the F-14, it can only be taken as a very rough estimate for the F-15.

11/ See text, p. 30.

12/ Estimates of escort requirements for nonnuclear carriers vary from five to seven per carrier. Since the most capable nonnuclear surface ships presently in the force are assumed to escort the carrier, five escorts are considered sufficient for this mission.

13/ Planning U.S. General Purpose Forces: The Navy, p. 28.

92-129 O - 77 - 6

during a crisis/war. The station was assumed to be 200 nm. from the carrier, the normal operating stations of E-2Cs. There is no need for wet-wing modification. The calculation of the E-2C force of eight aircraft is derived from estimates of the plane's speed and endurance, employing the force level calculation described on page 66:

$$F_e = \frac{E_e \times 720}{T_s \times U_e}$$

The total procurement requirement employs the E-2C factor noted above, 1.73, yielding a force requirement of 14 aircraft. Since four aircraft are already assumed as part of the normal carrier air wing, there remains an additional procurement requirement for ten planes.

Task Force Costs. The cost of the task force is the 15-year total of the annual operating cost of its individual units, added to the procurement costs for ten E-2Cs. 14/ The operating costs of the air wing reflect the costs of planes currently assumed to be aboard a carrier, plus four additional E-2Cs that have been added to the wing.

Estimates of these costs were derived from the CBO Defense Resources Model. As noted in Table 3, they total $5,188 million (in fiscal year 1978 dollars).

The "One Carrier/Five Escorts Procured" Option

Task Force Requirements. If a carrier must be procured, so must its associated escorts. It is assumed that, if a new carrier is procured, it will be the CVV, which is relatively less expen-

---

14/ The carrier force costs have been measured in 15-year totals rather than in 30-year life cycle terms to provide a direct comparison with the land-based aircraft option. The life cycle of the carrier air wing is 15 years, and it is generally assumed that surface warships undergo mid-life conversion at costs approximating 50 percent of their procurement costs. The 15-year comparison avoids this conversion factor, and provides equal life cycles for the aircraft.

sive than a Nimitz-class carrier. In any event, as noted above, the nuclear power which the Nimitz carrier would provide is somewhat superfluous in the North Atlantic G-I-UK context, given the shorter transit routes that apply in that region.

Two DDG-47 AEGIS destroyers are assumed to be procured in place of the Terrier cruisers. Three more DD-963s are procured as ASW ships. A smaller air wing is procured, consisting of two squadrons of fighters and ASW, support, and suppression planes in numbers similar to those of the sea control air wing noted above and in Table 3. Ten additional E-2Cs are procured for the airborne early warning mission.

Task Force Costs. The cost of the task force is the procurement cost of each of its units added to the 15 year operating costs of the surface ships and the carrier sea control air wing. Procurement of fighter planes assumed the 2.36 procurement/operation ratio for F-14s noted above. Procurement of other planes assumed the E-2C ratio of 1.73, reflecting a lower attrition rate for nonfighter aircraft.

The total cost of the air wing may be expressed as:

$$C_{aw} = \sum_{i=1}^{n} [(N_i)\ (C_{pi}) + (N'_i)\ (C'_i)\ 15]$$

where C_{aw} = Total cost of the air wing

N_i = Number of planes procured of type i

C_{pi} = Average unit procurement cost (fiscal years 1978-82) of planes of type i

N'_i = Number of operational planes of type i

C'_i = Annual unit operating cost of planes of type i

15 = Years of operating life

For the CVV air wing, the following are estimated to be numbers of procured and operational aircraft:

Type	Procured	Operating
F-14	57	24
S-3	17	10
EA-6	7	4
E-2	14	8
RA-7	3	2
KA-6	7	4
SH-3	10	6

The total 15-year cost of the air wing amounts to \$3,790 million. The total 15-year cost of the carrier force may be expressed as:

$$C_{cf} = C_{aw} + [C_{cv} + 15(C'_{cv})] + 2[C_{DDG} + 15(C'_{DDG})] + 3[C_{DD} + 15(C'_{DD})]$$

where C_{cf} = Total cost of the carrier task force

C_{aw} = Total cost of the air wing

C_{cv} = Carrier procurement cost

C'_{cv} = Annual carrier operating cost

C_{DDG} = DDG procurement cost

C'_{DDG} = Annual DDG operating cost

C_{DD} = DD-963 procurement cost

C'_{DD} = Annual DD-963 operating cost

and 15 = Number of years of operation

As noted in Table 4, the total 15-year carrier task force cost is \$9,276 million (in fiscal year 1978 dollars).

APPENDIX B. THE DD-963 AS AN FFG ALTERNATIVE

The FFG-7 initially was procured as one of the lower-cost systems in the "hi-lo" mix that Admiral Zumwalt had proposed for the Navy of the 1980s. In his view, it was extremely unlikely that the United States could maintain the requisite force levels to combat the Soviet threat if it chose to procure only expensive multipurpose ships. The FFG-7 class was seen as an adequate escort for lower-value assets, since it would face residual air, surface, and subsurface threats that were likely to have already encountered other, more capable U.S. forces.

The FFG-7 program has met with considerable criticism in recent years on several accounts. It has proved far more costly than originally planned: estimates of its unit cost rose from about $65 million to $168 million in constant dollars in just three years. 1/ At the same time, serious questions have been raised about its capabilities. Critics claim that the FFG lacks firepower and redundant sensors for operations in high-threat areas; that its single screw propulsion renders it vulnerable to attackers; that it lacks size and capacity for low-cost, mid-life modifications. Other critics have suggested that the FFG is too slow for conducting ASW operations against modern Soviet submarines. The House Armed Services Committee was particularly critical of the FFG program, and in fiscal year 1977 recommended that four DD-963 ships be procured in place of several of the FFGs that had been proposed in the President's fiscal year 1977 program.

The House Armed Services Committee argued that the DD-963 was twice as large as the FFG-7 and could mount guns that had longer ranges (5- or 8-inch) than the frigate's 76 mm. armament. The DD-963 had a more advanced sonar, the SQS-23, compared to the FFG SQS-56. Its Mark 4 torpedos were more capable than the Mark 32

1/ See House Armed Services Committee, Report Together with Separate, Additional, Dissenting, and Individual Views (To accompany H.R. 12438), 94-2 (1976), p. 33.

variety that the FFG would carry. The advantages of the DD-963 made it more cost/effective, in the Committee's view, although the DD-963 actually cost nearly twice as much as an FFG-7. 2/

The DD-963 certainly is the more capable system. The issue, however, is whether the FFG-7 provides sufficient capabilities for its mission, and whether the extra expenditure on the DD-963 is merited on the basis of mission requirements. Criticisms of the FFG-7 system tend to overlook the context in which it is to be employed. The FFG-7 is meant to escort lower-value units in medium-threat areas. 3/ Convoys are unlikely to enter high-threat areas; on the contrary, they would follow routes where the threat is less imposing. The FFG-7, therefore, will face those residual threats that have survived or avoided encounters with other more capable ASW or AAW units, such as interceptors, submarines, and patrol craft. The DD-963, on the other hand, is a carrier escort. It is likely to encounter more intense and sustained enemy activity while performing its particular escort mission.

The context of the FFG's operations also relaxes the speed requirement. The FFG is not meant to hunt submarines. In providing close-in defense for slow-moving convoys or replenishment ships, 4/ it will be limited by the speed of those ships. Additionally, the FFG, like all other ASW surface ships, probably will

---

2/ Ibid., pp. 33-34. The DD-963 referred to by the House Armed Services Committee, and addressed in this appendix, should not be confused with the air capable DD-963 which the Senate Armed Services Committee has recently called for (see Senate Armed Services Committee, Report to Accompany H.R. 5970, 95-1, 1977). This appendix does not discuss the relative merits of this DD-963 variant.

3/ House Armed Services Committee, Hearings on Military Posture and H.R. 11500 (H.R. 12438), Department of Defense Authorization for Appropriations for Fiscal Year 1977, Part 4, 94-2 (1977), p. 132.

4/ Some tankers can steam at about 30 knots, but other types of ships are far slower. A convoy of 40 or 60 ships can only move as fast as its slowest unit will permit.

not be able to steam at speeds in excess of 20 knots if it wishes to locate an enemy submarine. Hull mounted sonars simply do not operate as effectively at speeds above that level.

The fact that the FFG has a less capable sonar and torpedo than the DD-963 should not obscure the fact that it will have LAMPS helicopters and towed array sonar. The combination of these systems will permit it to detect and attack submarines at considerable distances from its own position. These systems, when added to its hull-mounted ASW capability, should provide it with adequate antisubmarine protection in an environment that is far less demanding than that for which the DD-963 is programmed.

Critics who point to the FFG's vulnerability because of its single screw propulsion overlook the fact that, when a surface ship is hit, it will suffer badly wherever the contact is made. Shipboard "hardening" on any ship is no real match for oncoming weapons, and the number of screws, or propeller shafts, is simply one form of hardening. 5/ It should also be noted that historically the addition of a second propeller has made no difference to the ship's survivability; in World War II, if one screw was disabled, so was the second. 6/

Critics have correctly pointed out that the FFG has limited space for low-cost, mid-life improvements, while the DD-963 has considerable space for such changes. The FFG does allow for improvement or alteration of certain types of key weapons systems, however, without forcing major alterations to the ship as a whole. Like any air-capable ship, the FFG can improve its aviation component quite easily. For example, it presently is programmed to carry the SH-2 helicopter. When the more advanced LAMPS III comes into service, it will carry those. Similarly, there should not be considerable difficulty modifying the tactical towed array system, when improvements are developed. The extended hydrophone system can be altered with only minor shipboard modifications, primarily with respect to the computer capacity on board. Lastly, it should

---

5/ See testimony of Vice Admirals James H. Doyle and Robert C. Gooding, HASC, Hearings on Military Posture, FY 1977, Part 4, pp. 37, 40, 41, and 168.

6/ Testimony of Admirals Doyle and Gooding, ibid., pp. 168-69.

be noted that even carriers frequently have to undergo major modifications if entirely new systems are added to their weapons suites. The SLEP program is an indication of the size and cost of these modifications.

Critics are, of course, correct that the FFG is a costly ship, relative to original cost estimates put forward by DoD. However, cost increases are certainly not unique to the frigate. The last set of DD-963, for example, cost about $111 million each in fiscal year 1978 dollars; a new DD-963 would cost well over twice as much, $260 million. The DD-963 cost increase is, in fact, almost that of the FFG-7, some 130 percent over the past four fiscal years.

There certainly are serious problems associated with the FFG program, and these cannot be overlooked:

- The LAMPS program is far too slow. Without an adequate helicopter that has a range in excess of 50 nm., full advantage cannot be taken of the possibilities offered by Tactical Towed Array Sonar (TACTASS). LAMPS is meant to enter the fleet in the early 1980s, in limited numbers. If the FFG is to be an effective ASW ship, the program should be reexamined, possibly accelerated, and the purchase increased.

- FFG is meant to have the Phalanx close-in weapons system. Phalanx has not yet proved itself capable.

- There have been problems with the hull-mounted sonar.

With the exception of the sonar, these problems also apply to the DD-963, however. They do not, in themselves, constitute a reason for procuring the more expensive destroyer in place of the frigate.

In sum, the FFG clearly is a limited ship, but its mission is limited. It would appear that the expenditure of twice the cost of an FFG for each unit that would replace it is not justified by the tasks to which those units would be assigned. Additionally, the high cost of the DD-963 would limit the number of escorts that could be built. The House Armed Services Committee acknowledged

this fact, but argued that the Allies had to play a greater role in providing escort and ASW capabilities. The Committee felt that the Allies could perhaps compensate for the FFG shortfall. 7/ To be sure, the Allies could contribute more to the maritime effort than they now do. But they do, in fact, contribute about 75 percent of all NATO naval forces. They are also modernizing their navies. As noted above, 8/ their present contribution has already been accounted for in setting U.S. escort requirements. And there is no indication that a cutback in U.S. escort production will stimulate a compensating increase in the allied contribution. Certainly, the decline in U.S. naval force levels since 1970 has not prompted that increase. In view of the questionable marginal value of the DD-963 in a low-threat escort role, it is problematical whether the U.S. should gamble to attempt to force the Allies to increase their contribution by limiting its own escort levels.

7/ HASC, Report (to accompany H.R. 12438), p. 33.

8/ See text, p. 49 and footnote 24.

APPENDIX C. THE PROSPECTS FOR LMNA

Recent discussions regarding a possible follow-on to the P-3 maritime patrol aircraft have focused on the ASW possibilities afforded by the concept for a moderately large, subsonic (about 450 knots) aircraft termed the LMNA (for Land-based, Multipurpose Naval Aircraft). The LMNA is envisaged to have far greater endurance than the P-3, maintaining a combat radius of as much as 1,500 nm, with total endurance of about 24 hours and total on-station patrol of about 15 hours. This additional speed and endurance would ensure that the plane in its ASW role could cover far larger tracts of ocean per hour, for more hours, and at greater distances than could the P-3. Furthermore, the LMNA's speed would enhance its defense. As the originator of the concept has noted, "running away can be a good defense." 1/ The LMNA could also be equipped with radars and defensive armament against oncoming missiles that might be fired from enemy aircraft or, indeed, from a submarine.

The LMNA is envisaged as a multipurpose plane; it could utilize its size, speed, and endurance in carrying out antiship strikes or as an interceptor against oncoming bombers. In the former case it might remain at high altitude, possibly utilizing remotely piloted vehicles (RPVs) for better surveillance and employing Harpoon for long-range attacks. As an interceptor, the LMNA would be most useful in the G-I-UK gap, where it would remain on patrols against bombers that it would detect with long-range radars and attack with long-range missile systems such as Phoenix.

Apart from range and time on station, it is, however, uncertain to what extent LMNA would add to present capabilities in all three sea control areas. With respect to ASW, it might be difficult to exploit fully LMNA's potential for greater on-station time than that of P-3, since the duration of its patrol might be

1/ William D. O'Neil, III, "Land-Based Multi-Purpose Naval Aircraft (LMNA) Concept," (processed: Office of the Secretary of Defense, 15 September 1976), p. 5. All LMNA characteristics outlined in the text are drawn from this study.

limited by the endurance of the crew. Furthermore, while LMNA might carry more defenses than P-3, it is doubtful whether there would be a need for them, given the present inability of Soviet missile-carrying fighters to reach likely ASW patrol areas. Were Soviet fighters or bombers capable of carrying air-to-air missiles at ranges that would permit them to attack patrol aircraft, it remains uncertain whether even LMNA could survive such attacks. 2/

While LMNA could perform a useful antishipping role, Harpoon can also be carried by the P-3 and other aircraft. Since, as noted above, Harpoon permits a plane to shoot at enemy warships beyond the range of their shipboard missiles, it is difficult to assess the value of LMNA's augmented defenses to its antishipping role.

LMNA's greater range and endurance clearly would permit it to remain on combat air patrol for longer periods of time and/or greater distances than those that fighters such as F-14 and F-15 presently can attain. Therefore, fewer planes would be required to support these stations if LMNA performed the air defense task in place of tactical fighters. LMNA could not match their speed and maneuverability, however, characteristics that are crucial for an interceptor's survivability once it has fired its long-range missiles. The loss of even one LMNA would be a serious blow to the air defense network in the North Atlantic, since the cost of LMNA (estimated at $80 million in fiscal year 1978 dollars) renders it unlikely to be procured in quantities that are as large as those of present fighter programs.

The notion of an aircraft capable of performing a variety of maritime missions is an attractive one. Given the uncertainties regarding the development costs of LMNA and the degree to which it really adds to the effectiveness of present forces, it would appear, however, that this concept deserves much closer scrutiny before action is taken to implement it.

2/ A Backfire armed with air-to-air missiles is likely to possess the range and endurance to chase and overtake the LMNA.

AEGIS: An integrated, computer-controlled air defense system, comprising a network of radars for tracking and targeting enemy projectiles, and associated missiles and missile launchers.

CARRIER TASK FORCE: A group of naval warships usually comprising an aircraft carrier, cruisers, and several additional destroyers. The cruisers and destroyers contribute to the defense of the carrier, primarily by means of their AREA DEFENSE systems, and antiship and antisubmarine weapons systems.

CHOKEPOINT: A geographic bottleneck (e.g., straits), through which ships must pass to reach open oceans or seas. Ships passing through chokepoints are vulnerable to enemy attack.

COMBAT RADIUS: The maximum one-way distance between a plane's base and the scene of its operations. The radius will vary with weapons load, fuel capacity, and required fuel reserves. It approximates half the planes's range.

DEFENSE-IN-DEPTH: A concept of concentric defenses protecting a high-value target such as an aircraft carrier. These defenses include:

AIRBORNE DEFENSES: Interceptors which attack incoming raids as much as hundreds of miles from the protected target.

AREA DEFENSES: Shipborne missile-firing systems that target missiles and planes that have survived interceptor attacks.

CLOSE-IN DEFENSES: Rapid-firing guns or short-range missiles that are fired at all residual attacking units.

ESCORTS: Naval vessels that are employed in the protection of ships they accompany. The protected ships may themselves be armed (e.g., carriers) or unarmed (merchant ships).

LINESMAN: U.K. Air Defense System, linked to NADGE.

MACH NUMBER: The ratio of the speed of an object to the speed of sound in the surrounding medium.

NADGE: NATO air defense network linking nine European countries. Includes 84 radar sites and electronic transmission facilities.

SEA CONTROL: Naval support of the relatively unimpeded transit of friendly shipping across selected sea lanes; denial of the enemy's ability to pursue similar operations in those areas. Includes:

> STRATEGIC SEA CONTROL: Attacks upon and destruction of threats to friendly shipping by means of operations conducted in areas remote from the sea-lanes.
>
> TACTICAL SEA CONTROL: Attacks upon and destruction of threats to friendly shipping in battles taking place near the sea-lanes.

SUBMARINE BARRIER: A line (or lines) of attack submarines usually stretching across a CHOKEPOINT.

ABBREVIATIONS

Ship Symbols

CV	All-Purpose Aircraft Carrier
CVN	All-Purpose Aircraft Carrier (nuclear-powered)
CVS	Antisubmarine Aircraft Carrier
CVV	Mid-Sized, Conventionally-Powered, Multipurpose Aircraft Carrier
DDG	Guided Missile Destroyer
FFG	Guided Missile Frigate
LHA	General Purpose Amphibious Assault Ship
SSBN	Fleet Ballistic Missile Submarine (nuclear-powered)
SSN	Attack Submarine (nuclear-powered)

Aircraft Symbols

AWACS	Airborne Warning and Control System (see E-3A)
E-2C	Navy Early Warning Aircraft
E-3A	Air Force Early Warning Aircraft (see AWACS)
EC-121	Air Force Early Warning Aircraft
F-4	Air Force, Navy, and Marine Corps Multipurpose Fighter/Attack Aircraft
F-14	Navy Air Superiority/Fleet Air Defense Fighter and Air-to-Ground Aircraft
F-16	Air Force Multipurpose Aircraft
LAMPS	Light Airborne Multipurpose System (Helicopter)
LMNA	Land-Based Multipurpose Naval Aircraft
LRA	Soviet Long-Range Aviation
MCRA	European Multirole Combat Aircraft
P-3	Naval Land-Based Patrol Aircraft
S-3	Naval Carrier-Based Patrol Aircraft

Other Abbreviations

AAW	Anti-Air War
AEW	Airborne Early Warning
ASROC	Antisubmarine Rocket
ASW	Antisubmarine Warfare
CAPTOR	Encapsulated Torpedo

CTG	Carrier Task Group
DoD	Department of Defense
G-I-UK	Greenland-Iceland-United Kingdom
NADGE	NATO Air Defense Ground Environment
SLEP	Service Life Extension Program
SOSUS	Sound Surveillance Underwater System
V/STOL	Vertical/Short Take-Off and Landing Attack Plane